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ENERGIZING CALIFORNIA'S FUTURE

Electrification with Power-Efficient Technologies

Final Report

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Executive Summary

This market study evaluates whether power-efficient electric appliances, combined with intelligent power management technologies, can enable full electrification of manufactured and mobile homes on existing 100-amp electrical service. Manufactured housing represents a critical, hard-to-reach segment of California's housing stock, with over 440,000 homes statewide, many of which rely on fossil fuels for space heating, water heating, cooking, and clothes drying. Electrical service constraints, coupled with high upgrade costs, long utility timelines, and regulatory complexity, are a major barrier to electrification in this type of housing. The purpose of this study is to identify technically feasible, cost-effective electrification pathways that avoid or minimize electrical panel and service upgrades while maintaining acceptable user experience and complying with applicable electrical codes. The findings are intended to inform program design, policy development, and future investments under the CalNEXT program and beyond.

To address these objectives, the project team conducted a comprehensive market study that included technology identification and characterization, scenario development and energy modeling, electrical code analysis, cost and qualitative impact assessment, and stakeholder engagement. The team individually evaluated power-efficient appliances and control technologies and bundled them into electrification scenarios applied to a representative 1,200-square-foot manufactured home modeled in two California climates. We evaluated each scenario for compliance using multiple electrical load calculation methods, including manufactured-housing-specific requirements and National Electric Code–based approaches. To compare tradeoffs among approaches, the team also assessed upfront equipment and installation costs, 10-year operating costs, qualitative user experience impacts, and directional total system benefit.

Stakeholder engagement with manufacturers, contractors, researchers, community organizations, and program partners informed key assumptions, supported validation of technical feasibility, and shaped the study's implementation guidance and recommendations. The analysis demonstrates that full electrification of manufactured homes on existing 100-amp electrical service is feasible today through strategic combinations of power-efficient appliances and, where needed, targeted load management technologies. Pathways that prioritize low-power, high-efficiency equipment frequently eliminate the need for whole home smart panels or electrical service upgrades, significantly reducing cost and complexity for homeowners.

Heat pump space conditioning is the most effective electrification measure, significantly reducing energy use, operating costs, and peak electrical demand compared with electric resistance systems. Heat pump water heaters also outperform resistance units on energy cost and TSB, with 120-volt models often sufficient to meet hot water needs within service limits. Low-power technologies such as 120-volt induction ranges and heat pump dryers substantially reduce peak loads, though some involve modest performance tradeoffs. In many cases, expensive smart panels are unnecessary, as a single smart circuit switch managing one high-load appliance can achieve code compliance at a far lower cost and with less curtailment. Directionally, scenarios that combine heat pumps with low-power appliances deliver higher total system benefit than the baseline electrification scenario due to reduced energy use, lower peak demand, and avoided transmission and distribution impacts.

There are many viable electrification pathways, but electrical load calculation rules introduce significant uncertainty. The National Electrical Code includes multiple load calculation methods, each of which can be difficult to interpret. The load calculation form for manufactured homes provided by the California Department of Housing and Community Development does not explicitly address load management technologies or the use of historical load data to establish a realistic baseline. As a result, it is often unclear which calculation method applies, how requirements should be interpreted, or how emerging technologies can be incorporated. This ambiguity remains a practical barrier to electrification projects and gives substantial discretion to the installing electrician. To address this uncertainty, the research team assessed code compliance using both load calculation methods so that electrification pathways would remain applicable under strict and flexible code interpretations.

These findings highlight the need for clear, consistent guidance for homeowners, electricians, Authorities Having Jurisdiction, and contractors. Load management is most effective when presented as a proactive, code compliant design strategy that complements efficient appliance selection rather than as a workaround to safety requirements. Stakeholders expressed strong interest in practical electrification pathways for homes constrained to 100-amp service, while noting persistent barriers related to affordability, program rigidity, and permitting uncertainty. Contractors and researchers emphasized the need for load calculation assumptions that better reflect actual household demand and clearer guidance on incorporating efficient appliances and load management within existing code frameworks. Community organizations and housing advocates stressed minimizing disruption, reducing upfront costs, and setting realistic expectations around performance tradeoffs to support durable electrification outcomes for manufactured home residents.

A recurring theme was that the availability of knowledgeable contractors may be as important as the availability of low-power devices themselves. Stakeholders consistently noted that specialized expertise in manufactured housing conditions, permitting pathways, and sequencing of upgrades could unlock adoption more effectively than additional niche products alone. This feedback directly informed the study's recommendations and the development of practical guidance materials. Based on this analysis, the study recommends:

- Empowering homeowners with information and guidance on electrification pathways that can avoid electrical service upgrades
- Engaging Authorities Having Jurisdiction to clarify load calculation pathways, including how MH 527, California's electrical load calculation form for manufactured homes, can incorporate power-efficient appliances and smart load management technologies
- Investing in contractor education and specialization focused on manufactured home electrification, including MH 527 requirements, appliance selection, permitting pathways, and sequencing of upgrades
- Supporting continued development and early market adoption of power-efficient electrification technologies, aligned with energy efficiency programs, that improve user experience, reduce peak demand, and (where applicable) use low–global warming potential refrigerants and grid-interactive features

Together, these actions provide a coherent path to translating the technical feasibility demonstrated in this study into scalable, equitable electrification outcomes for manufactured housing in California.

Abbreviations and Acronyms

Acronym	Meaning
AHJ	Authority Having Jurisdiction
CO_2e	Carbon dioxide equivalent
DHW	Domestic hot water
EMS	Energy management system
EVSE	Electric vehicle supply equipment
FHR	First hour rating
GHG	Greenhouse gas
GWP	Global warming potential
HCD	(California) Department of Housing and Community Development
HP	Heat pump
HPWH	Heat pump water heater
HUD	US Department of Housing and Urban Development
HVAC	Heating, ventilation, and air conditioning
ICC	International Code Council
IPMT	Intelligent power management technologies
IOU	Investor-owned utility
kW	Kilowatt
kWh	Kilowatt-hour
MMH	Mobile and manufactured home
MSA	Meter socket adapter
NEC	National Electrical Code

Acronym	Meaning
NEEA	Northwest Energy Efficiency Alliance
NFPA	National Fire Protection Association
PCM	Phase change material
RESNET	Residential Energy Services Network
Mt	Million metric tons
TOU	Time-of-use
TSB	Total system benefit
UEF	Uniform Energy Factor
VEIC	Vermont Energy Investment Corporation

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Introduction

This study investigated the potential for power-efficient appliances paired with intelligent power management technologies (IPMTs), including smart panels, circuits, switches, and plugs, to enable full electrification of California mobile and manufactured homes (MMHs) without costly service upgrades. IPMTs can dynamically manage energy loads to stay within existing electrical capacity, offering a scalable and cost-effective pathway to decarbonization for this hard-to-reach market segment. Electrifying the space heating end use in the over 440,000 MMHs in California could reduce emissions by approximately 0.6 million metric tons (Mt) of carbon dioxide equivalent (CO_2e) annually, or 18 Mt CO_2e over 30 years, according to the National Renewable Energy Laboratory's Residential Building Stock Analysis.

To document the potential electrification enabled by power-efficient appliances paired with IPMTs in California MMHs, the project team conducted a market study focused on full-home electrification in MMH units, particularly those constrained by limited electrical service capacity (typically 100 amps or less). Electrical service capacity limitations pose significant barriers to electrifying major end uses, including space and water heating, cooking, and clothes drying. Upgrading constrained electrical service is often prohibitively expensive, logistically complex, and time-consuming, with utility-side work potentially taking months or years to complete.

The study used a variety of real-world electrification scenarios – combinations of power-efficient appliances and IPMTs – that support full electrification of all four major end uses (cooking, clothes drying, water heating, and space conditioning) on 100-amp service. The methodology section outlines how the scenarios were configured and compared to viable pathways for MMH electrification, with a focus on the simplest, quickest, and least costly solutions. The initial findings presented in this report provide critical insights into the technical feasibility and strategic potential for electrifying MMH units without electric service upgrades. The results of this study inform future program design, policy development, and investment strategies aimed at accelerating MMH electrification and advancing energy equity.

Background

This study leveraged existing market research on power-efficient appliances and IPMTs to document how full-home electrification can be achieved on 100-amp service. These findings informed the development of the practical, cost-effective electrification approaches for MMH residents presented in this report.

The 2023 CalNEXT report, *Market Study of Household Electric Infrastructure Upgrade Alternatives for Electrification*, identified technologies that enable residential electrification without electrical service upgrades (Baranow, et al. 2023). Building on the CalNEXT work, the current study expands and updates the catalog of IPMT technologies identified in the previous study through technology evaluations, industry events, manufacturer interviews, and targeted online research. The usage fuel type patterns presented in the 2023 household electric infrastructure market study report informed the development of reference MMH prototypes used in the modeling and scenario analysis, which is described in the methodology section below.

Technologies that enable electrification without requiring an upgrade to a home's electrical service fall into two categories: power-efficient appliances and controls (i.e., load management devices that manage electrical loads across one or multiple circuits). Power-efficient appliances include but are not limited to: space heating and cooling systems, water heaters, cooking equipment, and clothes dryers. This equipment serves end uses that typically account for the highest residential electrical demand. The aforementioned CalNEXT study identified three types of commercially available controls technologies, which range in installed cost from a few hundred dollars to nearly $10,000, including:

- Circuit/outlet switches that alternate power between two exclusive loads. Basic models operate in a binary fashion, while advanced versions can modulate power dynamically, which is particularly useful for coordinating devices like electric vehicle supply equipment (EVSE).
- Smart circuit controls that monitor total household electricity demand and automatically reduce power to selected circuit(s) when usage approaches a configurable threshold.
- Smart panels that integrate multiple load management functions to optimize energy distribution across the home.

Electrification of even one end use could trigger an electrical capacity upsize, depending on the existing electrical system conditions and electric appliance selected. Several publicly available electrical load calculation tools make it relatively easy to assess the capacity for new electrical loads, including Mike Holt's Electrical Toolbox mobile app (Holt n.d.), the Watt Diet Calculator (Redwood Energy n.d.), and the Residential Electrical Service Upgrade Decision Tool (CalNEXT n.d.). These tools provide useful approximations for homeowners to plan electrification and guide discussions with their electricians; however, some challenges remain, both in terms of user friendliness and functionality.

The California Electrical Code is based on the 2023 revision of the National Electrical Code (NEC), formally published as National Fire Protection Association (NFPA) 70-2023 (Association n.d.). While this code governs most residential construction in the state, manufactured homes are regulated separately at the federal level by the US Department of Housing and Urban Development (HUD) and are not originally constructed to comply with the NEC (Regulations n.d.). California law further differentiates factory-built housing into six categories, three of which are mobile homes (CA Health & Safety Code § 18008 2025), manufactured homes (CA Health & Safety Code § 18007 2025), and factory-built housing that may be used as single-family residences and are therefore relevant to this study. The other three factory-built housing types are "commercial modular," "multifamily manufactured," and "recreational vehicle." Mobile homes and manufactured homes are distinguished solely by their date of manufacture, with June 15, 1976, marking the adoption of the HUD Manufactured Home Construction and Safety Standards (PART 3280—MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS 2026). Factory-built housing, in contrast, is constructed to the California Building Code rather than HUD standards and is subject to local permitting authority, including compliance with the California Electrical Code (CA Health & Safety Code § 19971 2025).

Once mobile homes and manufactured homes are sold and installed in California, any renovations or electrical upgrades fall under the jurisdiction of the California Department of Housing and

Community Development (HCD). Alterations require submission of an HCD Application for Alteration or Conversion Form HCD MH 415, (Development n.d.), along with electrical load calculations completed using Form HCD MH 527 (Manufactured Home Electrical Load Worksheet n.d.).

These regulatory requirements make electrical capacity analysis a critical prerequisite for electrification projects in manufactured housing, particularly given the prevalence of 100-amp electrical services in this housing stock. By comparison, factory-built housing follows standard local permitting pathways and must comply directly with the California Electrical Code, including NEC-based electrical service sizing requirements.

The NEC provides multiple methods for evaluating electrical capacity. These include two calculation methods for new construction, Part III and Part IV of Article 220, and two additional methods intended for retrofit scenarios. Section 220.83 estimates existing loads plus proposed new loads using prescribed demand factors, while Section 220.87 allows the use of maximum measured electrical demand multiplied by a 125 percent safety factor plus new loads to evaluate service capacity. The research team found that the two new construction load calculation methods, Section 220.83, and MH 527 can yield markedly different assessments of available electrical capacity.

In addition, research shows that peak household demand is typically well below code-calculated values in most single-family homes, meaning there is often substantial unused electrical capacity (Kaestner n.d.). By leveraging measured load data under Section 220.87, electrification measures can frequently be implemented without requiring costly service upgrades. This regulatory flexibility directly supports the objectives of this study, which builds on prior market research to demonstrate how electrification, including high-demand end uses, can be achieved within 100-amp service constraints, particularly in manufactured and modular housing contexts.

Objectives

This study asks which combinations of power-efficient electric appliances and control systems ("scenarios") enable electrification of space heating, water heating, clothes drying, and cooking in MMHs within existing electrical constraints. To answer this question, the study assesses appliance and control technologies, both individually and as part of system-level solutions. Each technology is evaluated for its electrical characteristics, energy use, cost (equipment, installation, operation, and maintenance), and its qualitative impacts on user experience, appliance functionality, and health. Appliance and controls combinations form electrification scenarios applied to a prototype manufactured home configuration in two California climates. The team performed load calculations to ensure compliance with the relevant electrical code and further analyzed scenarios that met code for economic and qualitative impacts on consumers.

This report presents an overview of IPMTs and their associated performance metrics, along with electrification scenarios for MMH that have been validated through load calculations. It also provides practical guidance for manufactured home communities to support incremental electrification while planning for fully electric homes. It emphasizes early coordination with contractors, utilities, and park managers, and provides prompts to help homeowners assess feasibility, size equipment appropriately, and identify incentives before major work.

The research delivers actionable electrification recommendations that prioritize affordability and ease of deployment. These recommendations are intended for state and local agencies, utility program designers, manufactured housing park owners, and nonprofit housing organizations. While the guidance is tailored specifically to manufactured housing, the findings are broadly applicable to other housing types seeking to pursue electrification strategies under constrained electrical service conditions.

Methodology & Approach

The project team identified and characterized relevant technologies, developed and compared electrification scenarios, engaged stakeholders, and produced a homeowner-friendly guidance document.

Technology Identification and Characterization

The project team used technology identification and characterization to assess and compare available electrification technologies, laying the foundation for informed solution selection. Within both major technology categories, the team created controls and power-efficient appliance subcategories to group equipment with similar functions. In some cases, only one model of equipment was identified within a sub-category, while in others, multiple models from different manufacturers were considered. For each subcategory, we selected a representative model of equipment based on its optimal balance of cost, functionality, and user experience.

Equipment costs were sourced from large national retailers, and where possible, the team averaged costs from three suppliers. We drew installation costs for the initial findings from previous CalNEXT work where available, as well as online sources.

Each power-efficient appliance alternative was evaluated based on its impact on the overall electrical load. Additionally, the team calculated the upfront costs associated with electrification, including equipment, installation, and any necessary home electrical upgrades, along with the ongoing operating and maintenance costs. In addition to these quantitative assessments, we reviewed qualitative aspects of each appliance and control solution and categorized them into advantages and disadvantages. These included characteristics such as form factors, user convenience, and typical usage patterns, which are not easily captured through technical specifications but are important for understanding real-world applicability.

Configuring Electrification Scenarios

Configuring electrification scenarios allowed the team to describe how we bundled technologies into coherent pathways for the draft and final report, and to access how different combinations enabled full residential electrification on 100-amp service.

Representative Home and Climate Characteristics

The team used a prototype manufactured home of 1,200 square feet with three bedrooms and four-person occupancy to estimate thermal and electrical loads, and then developed two foundational scenarios by using the prototype home to support evaluation of electrification strategies under a 100-amp service constraint:

1. **Reference home**: This scenario reflects a typical configuration where fossil fuel appliances are used for key end uses. It is based on findings from the 2023 CalNEXT *Mobile and Manufactured Housing Market Characterization Study*, which reported that most manufactured homes in California rely on natural gas/propane for water heating (98 percent), cooking (84 percent), clothes drying (53 percent), and space heating (66 percent).
2. **Base electrification case**: This scenario represents an electrified home using conventional electric technologies, which is typically low cost but frequently inefficient in terms of power and energy. To prevent overcurrent, the base electrification case requires an advanced load management smart panel capable of dynamically operating any combination of appliances within a configurable service limit.

The reference home and base electrification case scenarios served as the starting point to build "alternative scenarios." Alternative scenarios are combinations of low-power and load management technologies that are code-compliant and achieve full electrification. As a basis for cost modeling, the team configured the "reference home" and "base electrification case," as shown in Table 1 below.

Table 1: Overview of end uses for the reference and base electrification case homes.

End Use	Reference Home	Base Electrification Case
Cooking	Natural gas range	Standard electric range
Clothes drying	Natural gas dryer	Standard electric dryer
Water heating	Natural gas, storage tank	Electric resistance, storage tank
Heating	Natural gas furnace	Electric furnace
Controls	None	Smart panel with configurable service limit

We modeled two climate zones to represent the range of California climates. As shown in Table 13, among all the electrification scenarios, costs over ten years are dominated by operational costs in both the hot and cold cases. These extremes were selected to bracket the potential variation in ten-year costs; however, more moderate climates will have tradeoffs of cooling energy for heating energy, with the result that the total ten-year costs are expected to be largely similar to what is shown for the two representative climates. The team chose Crestline's design conditions, in

California Climate Zone 16, to represent the colder end of California's climate spectrum, which is marked by a high number of heating degree days and moderate cooling requirements. Palm Springs, in California Climate Zone 15, reflects the hotter extreme, characterized by significant cooling demands and minimal need for heating. The team used the ANSI/Residential Energy Services Network (RESNET)/International Code Council (ICC) 301 standard for calculating an energy rating index, which we used to model the space conditioning demands with the representative design conditions (International Code Council 2022). The thermal design conditions in the two representative locations are presented in below. Additional assumptions are detailed in Appendix A.

Table 2: Thermal design conditions for two representative locations.

Representative Location	Heating Design Temperature	Heating Degree Days (Hours)	Cooling Design Temperature	Cooling Degree Days (Hours)
Cooler Climate: Crestline, CA	28°F	3920 (94,080)	89°F	341 (8,184)
Hotter Climate: Palm Springs, CA	45°F	783 (18,792)	109°F	2,722 (65,328)

End-Use Consumption and Operating Cost

The team used annual energy consumption for the four electrification end uses to determine the impact on energy costs for electrification scenarios; we also used the same ANSI/RESNET/ICC 301 standard for modeling the heating and cooling loads generates water heating, clothes drying, and cooking energy consumption, with respect to the number of occupants and the efficiency of the appliance.

The electricity rate used to make cost comparisons is $0.50/kilowatt hour (kWh), which represents a midline future statewide average. While electric rates may be substantially higher than $0.50/kWh, or even lower, in the foreseeable future, the analysis does not attempt to capture the uncertainty of future electric rates. As shown in Table 13, the 10-year costs of all electrification scenarios are dominated by operational costs. Should future electricity rates be substantially lower than $0.50/kWh some of the scenarios could exhibit an inverted relationship between first costs and 10-year operational costs. On the other hand, a higher electricity rate will only further emphasize the benefits of efficient equipment. Reasonable variances in the electricity rate do not alter the findings. While time-of-use (TOU) rates are not explicitly modeled, technologies capable of optimizing TOU pricing were considered in estimating total system benefit (TSB) directionally. It is important to note that appliances designed to respond to TOU rates may offer additional cost savings to customers, although these benefits are not reflected in this analysis.

Electric Code Compliance

All four NEC load calculation methods are valid and can be used when altering or upgrading a home. However, the two methods that are specific to existing dwelling units require detailed knowledge of a particular home's installed electrical equipment. Since this project is an analysis of the manufactured housing market in California in general, not specific cases, the research team used HCD form MH 527 and the NEC "standard" and optional load calculation methods to perform load calculations to ensure compliance with the relevant code. For more details on load calculations, see the Findings section and Appendix B.

Electrification Scenario Comparison

The research team analyzed electrification scenarios that represent a fully electrified home consisting of a unique combination of electric appliances and control equipment. Electrification scenario comparison reveals the relative benefits and trade-offs of each pathway, helping to identify the most promising approaches.

For the reference case, base electrification case, and each of the alternative electrification scenarios, the team carried out a cost analysis to identify configurations with the most favorable upfront economics. Upfront costs were calculated using the individual costs of end-use appliances, control equipment, and installation expenses. For the 10 most cost-effective options, we calculated 10-year energy consumption and operational costs, and then evaluated the top five scenarios, ranked by total cost of ownership over a decade, for homeowner user experience impacts and directional effects on TSB.

TSB represents the total dollar value a measure provides to the electric and natural gas systems. It reflects avoided costs for energy, ancillary services, generation capacity, and transmission and distribution, accounting for time- and location-specific factors. This study did not quantify TSB; instead, it assessed whether each scenario would be expected to increase or decrease TSB relative to the base electrification case and summarizes the key drivers below.

All scenarios are expected to yield a net positive TSB relative to the base electrification case because they electrify end uses and use power-efficient technologies. To compare scenarios, the project team scored directional TSB impacts by comparing each scenario's appliance package to the reference case across six avoided-cost categories: energy, generation capacity, ancillary services, transmission and distribution capacity, high global warming potential (GWP) refrigerants, and greenhouse gas (GHG) emissions.

Each constituent appliance received up to one point (-5 to 5 total) using the criteria below, and points were summed for each scenario. Smart circuit controls received no additional points because they were assumed to shift load, not reduce it, and all packages remained within the 100-amp service capacity. Because all scenarios were electrified, GHG impacts were assumed to be consistent across scenarios and captured within the energy impact.

The team awarded a directional rating of -1 (worse), 0 (neutral) or 1 (positive) for each of the following dimensions based on the criteria below, as compared to the base electrification corresponding "comparison" appliance:

- **Energy benefit:** Annual energy consumption in kilowatt-hours (kWh)

- **Reduced transmission and distribution capacity needs:** Peak power demand in kilowatts (kW)
- **Generation capacity value:** Ability to support load shaving and load shifting through thermal storage, battery storage or other mechanisms
- **Ancillary services value:** Ability to support dynamic load shifting and participation in demand-response through built-in controls and communication functions
- **Reduced impacts from high-GHG and high-GWP gases:** When the technology used low-GWP refrigerants (reduced impacts from high-GWP gases)

Finally, we documented qualitative impacts to building occupants for each scenario, highlighting significant advantages and disadvantages of individual appliances comprising a particular electrification scenario. For example, heat pump water heaters (HPWHs) offer positive cooling and dehumidification benefits, while heat pump dryers may result in longer drying times.

Stakeholder Engagement and Guidance Development

Stakeholder engagement and guidance development describe the project team's approach to grounding the work in real-world needs and perspectives, fostering alignment and actionable outcomes. To collect feedback on the current state of the market and stakeholder knowledge, needs, and interests, the project team worked with the Ortiz Group to facilitate several focus groups and interviews. Stakeholders included park owners, residents, relevant community-based organizations (CBOs), and local advocates, as well as technical stakeholders such as contractors. Together, these participants represented both community-facing and technical perspectives, including those with direct experience in resident engagement, program delivery, permitting processes, and retrofit conditions in manufactured housing communities. The project team's focus groups and interviews included two focus groups with MMH residents, four interviews with park management (park managers and HOA), two interviews with CBOs and advocates, and two interviews with contractors serving MMH residents.

To support dissemination of findings and address identified stakeholder needs, the project team developed a customer-facing guidance document for manufactured home electrification. The document is designed to help households prioritize and sequence electrification upgrades and identify appropriate combinations of power-efficient appliances and intelligent power management technologies. We incorporated insights from focus group discussions with manufactured home residents and CBOs to ensure the guidance reflects real-world conditions and is accessible, practical, and responsive to resident priorities.

Finally, the project team engaged a range of market stakeholders to gather input on the project's direction and approach. A summary of this stakeholder engagement is provided in Table 3 below. Additional qualitative insights collected as part of this effort are synthesized and presented in the Findings section below.

Table 3: Summary of stakeholder engagement.

Stakeholder	Purpose of Status and Engagement
The Ortiz Group	Several conversations with colleagues at The Ortiz Group to shape the stakeholder engagement scope as well as draft interview and focus group guides. Suggestions regarding engagement methods, barriers to consider when framing questions, and general question guidance were shared.
Home Energy Academy	A conversation with the founder of the education platform Home Energy Academy to share our project approach and collect feedback and suggestions, particularly regarding education and information dissemination.
Lawrence Berkeley National Laboratory	A conversation with the leader of the Lawrence Berkeley National Laboratory's Residential Building Systems Group to discuss further engagement opportunities, emerging technologies to consider, and provide feedback on project approach. Considerations regarding NEC calculations, load order, and infrastructure challenges were shared, and further engagement with contractors and Authority Having Jurisdictions (AHJs) was suggested.
POWER GROUP	Several communications with members of the POWER group to share our project approach and collect feedback and suggestions, as well as identify opportunities for additional stakeholder collaboration.
Electric Power and Research Institute (EPRI)	A conversation with the leader of a project that built three fully electrified new construction manufactured homes served by 100-amp service. Lessons learned shared an input sought on the CalNEXT research project approach.
CalNEXT ET22SWE0057 Project Team	Several conversations with Vermont Energy Investment Corporation (VEIC) colleagues to understand how to best apply the research and findings from the project's Market Study of Household Electric Infrastructure Upgrade Alternatives for Electrification to inform the creation of the reference home and base case scenario for this research.

Findings

Overview

This section summarizes the technologies evaluated and the results of the scenario analysis, beginning with an overview of the control devices and power-efficient appliances identified for manufactured and mobile homes, with additional detail provided in Appendix C. Next, we present the electrification scenarios that achieve full electrification within a 100-amp service constraint, including results from load calculations and comparisons of upfront costs, 10-year operating costs, user experience considerations, and directional TSB. The section concludes with a discussion of current market barriers and gaps, market opportunities, and stakeholder feedback to inform future recommendations.

Technology Identification and Characterization

The project team identified and characterized the control devices and power-efficient appliances, with additional details on technologies provided in Appendix C. The following sections explain how each control and power-efficient appliance technology works and summarize each technology's application to electrifying a home according to the following characteristics:

- **Electrical**: Effectiveness at avoiding a service upgrade per the electrical code
- **Cost:** For the equipment, installation, electrician work, and ten years of operation
- **Advantages and disadvantages:** Focusing on function and ancillary benefits (health, safety, reliability, and other benefits)

Control Devices

The following technologies are recognized by NFPA 70-2023 as compliant methods for managing or limiting electrical loads in single-family homes:

- **Smart panels and energy management systems (EMSes)** that monitor and control total household load are addressed in Section 220.70 of the code. These systems can be programmed to limit current to a feeder or service, and their maximum ampere setpoint may be used in load calculations.
- **Simpler load-switching devices** are covered under Section 220.60, which allows for coincidental loads to be calculated based on the largest load expected to operate at one time.
- **Battery energy management systems are not covered in this market study** and do not appear under NEC Sections 750.30 and 220.70. Although this technology is promising for its ability to limit load to the grid while not curtailing household end uses, it is still emerging and not widely available. Note that control devices enable compliance with the electrical code, but do not improve energy efficiency or reduce overall electricity consumption.

Often, an expensive smart panel isn't needed to meet code in most cases. A targeted smart load switch is usually a better investment than a whole home smart panel. A smart load switch controlling one key load can provide the required margin at a fraction of the cost. Because these switches monitor total household demand in real time, they curtail only when the service is nearing its limit. Research shows that the maximum load in 98 percent of homes is less than 100 amps. The maximum load in 75 percent of homes is less than 47.9 amps (Less 2026). As a result, the controlled appliance is rarely interrupted. Simple circuit splitters, by contrast, always block one appliance whenever the paired circuit is active, creating unnecessary inconvenience. Because of the negative user experience associated with unnecessary curtailment, load splitters were not considered in the analysis. An overview of the technologies is presented in Figure 1 below.

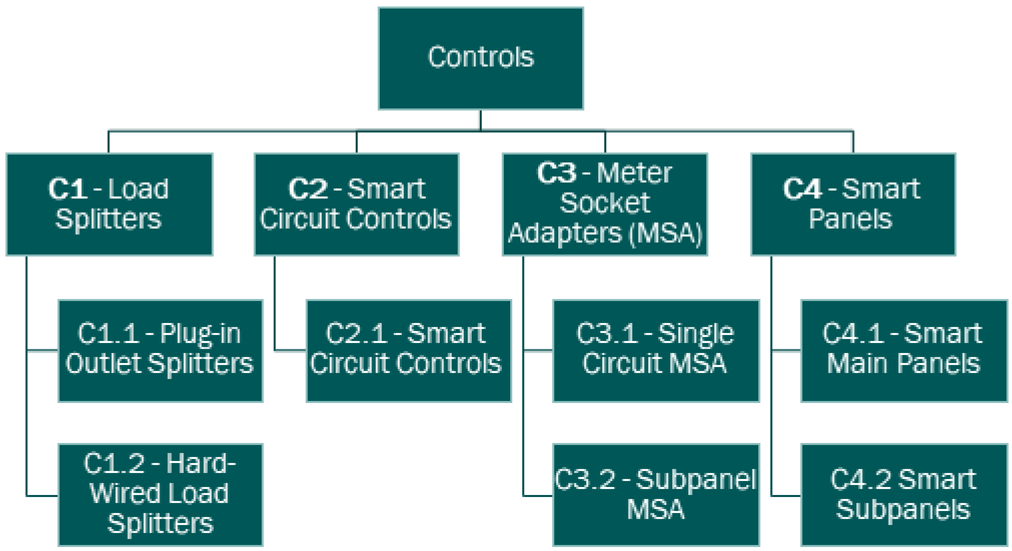

Figure 1: Overview of control technologies.[1]

[1] C1, C2, etc. refer to the corresponding data table in Appendix B.

C.1. LOAD SPLITTERS

Description: There are two varieties of load splitters: plug-in and hard-wired splitters. Plug-in devices (C1.1) plug into a single 240 V outlet and have two 240 V receptacles for primary and secondary loads. Hard-wired devices (C1.2) are wired to a subpanel or the main panel and have two 240 V output lines connecting the primary and secondary loads, either via outlets or wired directly. Both types allow two electrical loads to share a single outlet or circuit, with only one load operating at a time. The primary load takes precedence, and the secondary load is paused during its operation. Common applications include alternating use between a clothes dryer and a hot water heater or an electric vehicle charger. Research suggests that alternating usage between appliances is only minimally inconvenient for most users (Walker 2025). Table 4 provides a comparison of C1.1 and C1.2 technology advantages and disadvantages.

Cost: Plug-in splitters cost between $300 and $500 and do not require professional installation. Hard-wired splitters are priced over $1,000 and require installation by an electrician.

Table 4: Comparison of load splitter technologies.

Technology	C1.1 Outlet Splitters	C1.2 Hard-Wired Splitters
Advantages	• Easy to install; no professional installation needed • Less expensive • Quicker installation	• Can be set up to share any two 240 V circuits • Not restricted to end use proximity
Challenges	• Restricted to appliances that are physically next to each other • Users may notice load curtailment since two end uses cannot be used simultaneously	• Expensive • Requires an electrician • Users may notice load curtailment since two end uses cannot be used simultaneously

C.2. SMART CIRCUIT CONTROLS

Description: Smart circuit controls use current transformers with internal logic to monitor the home's total electrical usage. They energize connected loads only if doing so does not exceed the preset limit, typically 80 percent of the service capacity. This dynamic control helps prevent overloads while avoiding curtailment when there is sufficient capacity.

Cost: Installation by an electrician is required. The combined equipment and installation cost is around $1,000.

Advantages: These controls provide intelligent, real-time load management and are effective at preventing overload. They are compliant with NFPA 70-2023. Unlike load splitters, which always disable one of the loads, smart circuit switches only disable the connected appliance if the home's total electrical load would exceed the service limit, which is a rare occurrence in a typical home (RHA 2024).

Challenges: Installation by an electrician is required. The use of a smart circuit switch is typically limited to managing a single connected load, and it may prevent use of that connected load if other electrical usage is high.

Table 5 highlights the aforementioned advantages and challenges of smart circuit controls.

Table 5: Overview of smart circuit brands.

Technology	C2.1 Smart Circuit Controls
Advantages	• Intelligent, real time load management effective at preventing overload • NFPA 70-2023 compliant • Only disables connected appliances as needed
Challenges	• Requires installation by electrician • Management limited to a single connected load

C.3. METER SOCKET ADAPTER TO INDIVIDUAL LOAD OR SUBPANEL

Description: Meter socket adapters (MSAs) are installed between the utility meter and the meter socket, allowing power to be routed directly to a subpanel or EV charger. The MSA monitors current on the service connectors and will power the connected device only if the main panel load is below 80 percent of service capacity (80 amps for 100-amp service.) MSAs prioritize household loads over their connected device(s) and are available for connection to a single load or to a subpanel supporting multiple loads.

Cost: Both MSA types require an electrician for installation. MSAs that connect to a single load, often an electric vehicle charger, but not exclusively so, are significantly less expensive and simpler to wire than MSAs that include a subpanel. MSAs with a subpanel offer many of the advantages and flexibility of a smart panel for lower equipment and installation cost.

Advantages: MSAs offer a cost-effective and non-invasive way to add new loads, such as electric vehicle chargers, without replacing the main panel or upgrading the electrical service. Within the NEC, an MSA is included in the category of EMS. Installation is straightforward, and existing house wiring remains untouched, making this a practical solution for many homes.

Challenges: These devices are limited to the loads routed through them and are not suitable for manufactured homes in parks where the meter is located remotely. Additionally, while installation is simpler than a smart panel, it still requires a licensed professional.

Table 6 provides a comparison of advantages and disadvantages between C3.1 and C3.2 technologies.

Table 6: Overview of MSA to load technologies.

Technology	C3.1 MSA to Subpanel	C3.2 MSA to Single Load
Advantages	• Less expensive than a smart panel • Flexible: Add 8 to 16 new circuits without touching the household electrical system • Monitors the service conductor current to ensure that the total service load remains within safe limits	• Inexpensive • Add an EV charger without touching the household electrical system • Monitors the service conductor current to ensure that the total service load remains within safe limits
Challenges	• May limit the use of some appliances some of the time	• May limit the use of the connected load some time • Only powers one load • Only powers EVSE

C.4. SMART PANELS

Description: Smart panels include integrated current transformers and energy management software. These systems monitor and manage branch and total house loads, ensuring total electrical demand stays below a programmed set point, typically 80 amps for homes with 100-amp service. Smart panels can entirely replace a home's main electrical panel or be installed as a subpanel to a traditional panel.

Cost: Smart panels cost four to five times more than standard ones, with equipment alone often exceeding $4,000. Installation, including disconnecting and reconnecting circuits, panel replacement, and system commissioning, typically adds $1,300 to $1,600 in labor. Additional costs may apply for programming and commissioning, as well as wiring and safety upgrades.

Advantages: Smart panels are highly effective in enabling full electrification without requiring an electrical service upgrade. They are compliant with the California Electrical Code, making them a robust solution for managing household electrical loads. Smart panels connect to an app included which enables monitoring of the current and reports the historical power usage of every connected load. Connected loads can be turned off or on through the app either on demand or by programmed schedule. The app provides energy saving tips based on analysis of usage patterns. When household usage is high, smart panels can reduce power to compatible connected devices rather than fully shutting them off. For example, an EV charger could be adjusted down to 20 amps from 40 amps rather than shut off completely. Smart panels can also manage the use of household backup batteries during power outages.

Challenges: Smart panels are expensive and require substantial installation work, especially in manufactured homes where wiring is harder to access and interior finishes are more difficult to repair, and they do not improve efficiency or reduce electricity use. Smart panels in lieu of efficient appliance can result in excessive curtailment, which may be inconvenient. Table 7 provides a comparison of advantages and disadvantages between C4.1 and C4.2 technologies.

Table 7: Comparison of smart panel technologies.

Technology	C4.1 Smart Main Panel	C4.1 Smart Subpanel
Advantages	• Monitoring and control of every household electrical load (up to 40)	• Monitoring and control of every connected electrical load (up to 16) • Less expensive than full replacement of the main panel
Challenges	• Installation requires every load to be disconnected from the old panel and reconnected to the smart panel, leading to higher installation cost than for the subpanel	• Only loads serviced by the subpanel can be monitored or controlled

Power-Efficient Appliances

The following power-efficient alternative appliance technologies are described below for each of four end uses: cooking, clothes drying, water heating, and space conditioning. Similar technologies are combined into subcategories under each end use, as summarized in Figure 2.

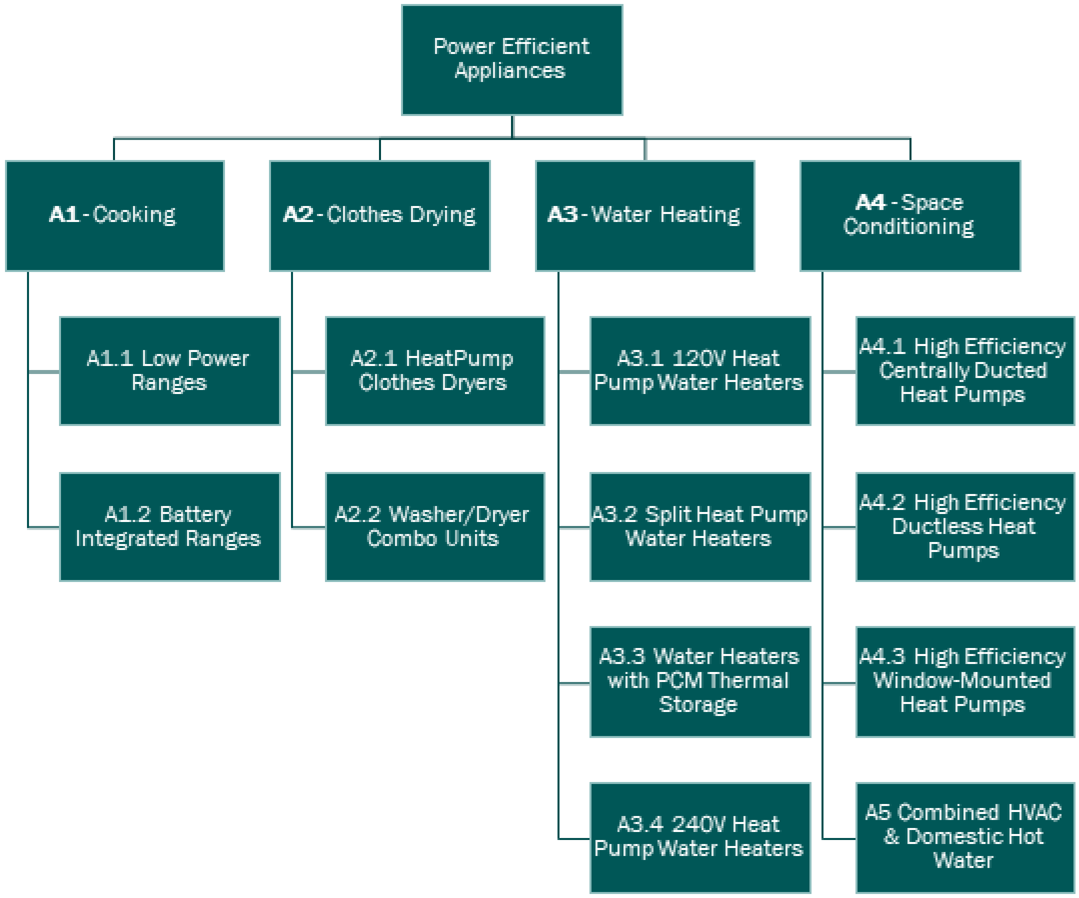

Figure 2: Overview of power-efficient technologies by appliance c[2].

Appendix C includes a comparison of the reference case fossil fuel appliances, base electrification case electric appliances, and power-efficient electric appliances. Detailed information, such as technical specifications, costs, and notes about functional capability, and any notable pros and cons, also appear in Appendix C.

A.1. LOW-POWER AND BATTERY-INTEGRATED COOKING RANGES

Description: These cooking ranges have a far lower electrical load compared to traditional 240 V electric stoves. Battery-integrated models use a 120 V circuit to charge an internal battery that supplies peak cooking power and enables limited operation during power outages. Non-battery 120 V induction ranges provide sufficient cooking capacity with lower power draw.[3] Efficiency, and therefore, operating costs, are comparable between 120 V and 240 V induction ranges, with or without battery integration.

Cost: Battery-integrated models range in cost from $4,000 to $6,000 (Electra n.d.) (Copper n.d.), and non-battery 120 V induction ranges are expected to cost under $2,000 when released onto the market (Redwood Energy 2022). 240 V electric ranges with radiant cooktop elements are

[2] A1, A2, etc. refer to the corresponding data table in Appendix B

significantly less expensive but require the added cost of installation of a 240 V outlet when converting from fossil fuel stoves.

Table 8 provides a comparison of advantages and disadvantages between A1.1 and A1.2 technologies.

Table 8: Comparison of low-power and battery[3] induction ranges.

	A1.1 Low Power Induction Range, No Battery	A1.2 Battery Integrated Induction Range
Advantages	• Similar price to traditional 240 V induction stoves • Similar weight to a traditional 240 V range, ~150 lbs	• Ability to cook three to five meals in a power outage • Ability to reduce electric bills by optimizing time of use rates • Can plug into a standard 120 V NEMA 5-15R receptacle, but the manufacturer recommends a dedicated 120 V, 20 A circuit with a NEMA-5-20R receptacle • Future models may have an outlet to power additional appliances during an outage
Challenges	• Only 3 induction burners, which may not be sufficient for all users • Requires a dedicated 120 V, 20 A circuit with a NEMA-5-20R receptacle, which may or not be available	• Much heavier than traditional ranges, 354 lbs. vs. ~150 lbs. (difficult to move and may require additional floor reinforcement for manufactured homes) • High upfront cost

A.2. HEAT PUMP CLOTHES DRYERS AND WASHER/DRYER COMBOS

Description: Heat pump dryers work by circulating air in a continuous loop from the drum through an evaporator and condenser before going back to the tumbler. As air from the drum passes over the cold coil, moisture condenses and drains away. The cool and drier air then flows through the hot condenser coils, warming the air, which then re-enters the tumbler to absorb moisture from the clothes. Unlike HPWHs, heat pump (HP) dryers do not cool the room; they are essentially dehumidifiers that remove moisture from clothes and discharge that collected water into a reservoir or to a drain through a condensate line. HP dryers are available in 120 V or 240 V models, while washer/dryer combos are all 120 V and integrate both washing and drying; they are available with either heat pump or resistance drying systems.

[3] See Table A1 in Appendix B for more information.

Cost: Electric resistance dryers cost about $700 to $800 but require the installation of a 240 V outlet, as do 240 V HP dryers. 120 V or 240 V HP dryers, which are between 1.5 and 2.3 times as efficient as electric resistance dyers (FSEC 2016), and washer/dryer combos all cost about twice as much as a standard electric resistance dryer, in the range of $1,400 to $1,800. Over the course of a decade, all HP options have lower operating costs than electric resistance options.

Advantages: HP dryers have lower energy use, are gentler on clothing (NEEA 2017), and have much lower nameplate electrical load ratings than electric resistance dryers.

Challenges: HP clothes drying takes up to twice as long compared to electric resistance[8] and clothes may feel cool or damp after drying is concluded (Whirlpool n.d.).

Table 9 compares the advantages and disadvantages between appliances A2.1 and A2.2.

Table 9: Comparison of HP clothes dryers and combined washers and dryers.

	A2.1 120 V Heat Pump Dryer	A2.2: 240 V Heat Pump Dryer	A2.3: Combined Washer/Heat Pump Dryer
Advantages	• Avoids the need to install a 240 V outlet. Requires only a 120 V 15 A standard outlet	• Modestly more efficient than 120 V heat pump dryers • Same large load capacity as electric resistance dryers, typically around 7.4 to 7.8 cu. ft.	• Avoids the need to install a 240 V outlet • Convenient to not move laundry from washer to dryer
Challenges	• Smaller capacity, often 4.0 to 4.6 cu. ft.	• Requires installation of a 240 V outlet	• Smaller capacity, often 4.0 to 5.3 cu. ft. • More difficult installation due to greater weight, 302 lbs.

A.3. WATER HEATING

Description: Electric water heating options include standard electric resistance tank heaters, 240 V hybrid HPWHs, 120 V unitary HPWHs, split HPWHs, and water heaters that use phase change material (PCM) for thermal storage. HP models operate by extracting heat from the surrounding air to heat water, which offers greater efficiency than resistance heaters. 240 V HPWHs and 120 V unitary HPWHs are self-contained units that extract heat from inside air to heat water. In a manufactured home without a basement, they are typically located in a closet with a louvered door or in a bathroom. Split HPWHs have an indoor tank that houses the condenser coils, along with an outdoor unit that houses the evaporator.

PCM water heaters use resistance heating but store heat in a PCM inside a compact, insulated tank. Despite differences in technology, most models offer similar first-hour ratings, ensuring adequate hot water supply for typical household needs. All four models compared also can be optimized for TOU electric rates.

Cost: Standard electric resistance water heaters have the lowest upfront equipment and installation costs, while both unitary and split HPWHs have higher initial costs but are more energy efficient. The upfront and operating costs of PCM water heaters fall in between those of electric resistance and HPWHs.

Table 10 compares the advantages and disadvantages between A3.1, A3.2, A3.3, and A3.4 water heating technologies.

Table 10: Comparison of water heater technologies.[4]

	A3.1: 120 V Unitary HPWH	A3.2 120 V Split HPWH	A3.3 PCM Water Heater	A3.4 240 V Hybrid HPWH
Advantages	• During heating season, cools and dehumidifies the room it is in • Plug into 120 V outlet • Energy savings	• Does not affect indoor temperature or humidity • Lower indoor noise • Plug into 120 V outlet	• Does not affect indoor temperature or humidity • Physically smaller than other tank water heaters, work in many situations where HPWHs will not work	• During the heating season, it cools and dehumidifies the room it is in • Energy savings • Higher first hour rating (FHR), 67 gallons, than a 240 V electric resistance tank water heater, 61 gallons, or a 120 V HPWH, 55 gallons
Challenges	• Slower recovery rate (at 90°F rise), 12 GPH, than other options • Space for installation is sometimes not available • Improper installation can result in mold and interior damage • During the heating season, it cools and dehumidifies the room it is in • Noise a nuisance to some depending on installation location • Requires installation of a condensate line	• Added cost of running refrigeration lines between the indoor and outdoor units. • Most expensive of the options	• Require installation of a 240 V outlet • Less energy efficient	• Space for installation is sometimes not available • Noise a nuisance to some depending on installation location • Improper installation can result in mold and interior damage • Requires installation of a condensate line • Requires installation of a 240 V outlet. • Includes 4,500 W resistance elements. If used often, efficiency benefit is reduced

[4] See Table A3 in Appendix C for more information.

A.4. SPACE CONDITIONING

Description: Most manufactured homes in California use centrally ducted gas or propane downflow furnaces, often paired with central air conditioning. Of homes with natural gas, about 21 percent lack ductwork and rely on wall-mounted heaters. For electrification, ducted homes can use a low-cost 15-kW electric resistance furnace or opt for a more efficient ducted HP, whereas homes without ductwork can electrify with baseboard heaters, though ductless mini-splits and window-mounted micro heat pumps offer greater efficiency.

Cost: Electric downflow furnaces and electric baseboard heaters have lower first costs than the efficient HP alternatives explored in this research. A centrally ducted cold climate HP that uses existing ductwork has similar combined equipment and installation costs to high efficiency window-mounted heat pumps. Ductless HPs are the most expensive of the three options, while the most power-efficient option is the window-mounted HP. All three technologies offer significant energy efficiency and operational cost savings over the lower first-cost electric alternatives.

Advantages: All three HPs provide significant long-term savings and improved comfort through variable speed operation and better temperature control, and they eliminate combustion-related carbon monoxide and health risks, compared to their fossil fuel alternatives. Additionally, the HP alternatives all have the advantage of providing more efficient cooling than the legacy centrally ducted air conditioning unit or window-mount air conditioners that they would be replacing.

Challenges: Electric resistance heating is among the most expensive options to operate, often resulting in significantly higher annual heating costs compared to gas systems. Although heat pump systems offer greater efficiency and lower operating costs over time, they require higher upfront equipment and installation costs. Finally, the steady, lower-temperature heat output of heat pump models may require an adjustment period for occupants, but it may ultimately enhance user comfort.

Table 11 compares the advantages and disadvantages between A4.1, A4.2, and A4.3 space conditioning technologies.

Table 11: Comparison of power-efficient space conditioning technologies.[5]

	A4.1 Centrally Ducted – High Efficiency Heat Pump	A4.2 Ductless – Packaged Window Heat Pumps	A4.3 Ductless – High Efficiency Heat Pumps
Advantages	• Can use the existing ducting in a home for easier installation and good heating and cooling distribution throughout the home	• Uses existing electrical outlets • Multiple units = multiple heating and cooling zones • Much easier installation than other options	• Multiple units = multiple heating and cooling zones
Challenges	• Ducting in manufactured homes is under the floor and is often not well insulated. Duct sealing and insulation may be required to ensure good system performance • Single zone	• May not work for all homes if there are not enough suitable windows	• Ductless heat pump installation can be difficult if wall space is limited for indoor units or if space outside is limited for three separate outdoor units

A.5. COMBINED HEATING, VENTILATING, AIR CONDITIONING (HVAC) AND DOMESTIC HOT WATER (DHW)

Description: These combined HVAC and DHW systems integrate space conditioning and water heating into a single system using air-to-water heat pumps. The project team evaluated products from at least two manufacturers, both of which circulate hot or cold water through a hydronic loop connected to an air handler. These systems use water coils instead of refrigerant coils for space heating and cooling. Additionally, they recover waste heat from the compressor during cooling mode to heat domestic hot water, eliminating the need for a separate water heater and its associated electrical load.

[5] See Table A4 in Appendix C for more information.

Cost: These integrated systems are among the most expensive electrification options considered. The high equipment and installation costs result in long payback periods, making them financially impractical for most manufactured homes.

Advantages: For homes with 100-amp electrical service, these systems offer two key benefits. First, by combining space conditioning and water heating, they eliminate the need for a separate water heater, reducing the total electrical load. Second, they improve efficiency by capturing and repurposing waste heat from the cooling process to heat water, which would otherwise be lost to the atmosphere. Refrigerant is self-contained in the outdoor unit; installers do not need to run refrigerant lines or do other complex refrigeration setup tasks.

Challenges: Despite their innovative design, the efficiency gains over conventional systems are modest, particularly during heating season when the system must balance space heating and water heating demands. The high upfront cost and limited return on investment make these systems less attractive for widespread adoption in manufactured housing. Their complexity and installation requirements may also pose barriers for contractors and homeowners unfamiliar with hydronic systems.

Table 12 compares the advantages and disadvantages of A5.1 and A5.2 technologies.

Table 12: Comparison of combined HVAC and DHW technologies.

Technology	A5.1 Combined HVAC and DHW with thermal storage	A5.2 Combined HVAC and DHW
Advantages	• Can take advantage of time-of-use electricity rates by running during off-peak times and storing thermal energy for on-peak times. • CO2 refrigerant has a very low global warming potential	• Less expensive than Harvest Thermal. • Provides air conditioning • During cooling mode, provides heat recovery to capture waste heat for water heating
Challenges	• The most cost-effective configuration does not offer air conditioning • More complicated and expensive to install than standard HVAC configurations	• Less efficient than A5.1 • Does not provide thermal storage to take advantage of time-of-use rates • Traditional refrigerants

Electrification Scenarios Results

The electrification scenarios below combine power-efficient appliances and, where needed, control technologies to enable full electrification of a manufactured home within a 100-amp service limit. Ten scenarios, including the base scenario, were evaluated on code compliance using MH 527 and/or NEC methods, upfront cost (equipment, installation, and any electrical upgrades), 10-year operating cost (electricity), user convenience (appliance performance and availability), and TSB impacts on the electric grid, all of which are summarized in Table 13. The team evaluated all ten scenarios for electrical code compliance, and modeled annual energy use for both cold and hot climate conditions. Figure 3 and Figure 4 summarize each scenario's total cost (upfront cost plus ten years of operating costs) under medium electricity-rate assumptions.

Despite using lowest first-cost appliances, the base electrification scenario had the highest total upfront cost due to the cost of the smart panel, which is necessary to meet electrical code requirements. It also had the highest operating costs due to its use of inefficient appliances.

Table 13: Top ten scenarios summary.

Scenario		Base Scenario: Smart Panel and Lowest First-Cost Electric Equipment	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9
Load Calcs	**MH 527 (amps)**	170.2	95.2	82.7	77.9	100.8	55.1	104.8	95.3	87.4	102.5
	NEC Standard (amps)	163.4	108.2	94.0	73.2	94.8	72.0	96.8	90.6	100.5	96.6
	NEC Optional (amps)	110.5	79.3	68.4	67.0	75.7	57.4	74.3	72.8	73.6	75.2
Appliances	**Space Conditioning**	Electric furnace, three window-mount AC units	Electric furnace, three window-mount AC units	Three-zone ductless heat pump	Centrally ducted heat pump	Centrally ducted heat pump	Centrally ducted heat pump	Centrally ducted heat pump	Three window-mount heat pumps	Three window-mount heat pumps	Three window-mount heat pumps
	Hot Water	Electric resistance tank hot water heater	120 V heat pump water heater	120 V heat pump water heater	120 V heat pump water heater	240 V heat pump water heater	120 V heat pump water heater	240 V heat pump water heater	120 V heat pump water heater	120 V heat pump water heater	Electric resistance tank hot water heater
	Cooking	Electric cooking range	120 V induction range	Electric cooking range	Electric cooking range	Electric cooking range	120 V induction range	120 V induction range	Electric cooking range	Electric cooking range	Electric cooking range
	Clothes Drying	Electric resistance clothes dryer	Heat pump dryer, large capacity	Washer/heat pump dryer combo	Electric resistance clothes dryer	Electric resistance clothes dryer	Heat pump dryer, large capacity	Electric resistance clothes dryer	Electric resistance clothes dryer	Heat pump dryer, large capacity	Electric resistance clothes dryer

	Controls	Smart Panel			Smart circuit switch (dryer)	Smart circuit switch (dryer)					Smart circuit switch (dryer)
Upfront Costs (Equipment, Electrical, and Installation)		$19,864	$12,390	$17,256	$17,476	$18,176	$14,572	$14,822	$17,403	$17,853	$17,663
Cold Climate (Crestline, CTZ 16)	Annual Operating Cost ($0.50/kWh)	$6383	$5824	$2205	$2456	$2368	$2425	$2337	$2382	$2366	$3291
	10-Year Total Cost of Ownership	$83,693	$70,628	$39,309	$42,032	$41,853	$38,824	$38,195	$41,226	$41,518	$50,572
Warm Climate (Palm Springs, CTZ 15)	Annual Operating Cost ($0.50/kWh)	$3921	$3303	$1854	$2382	$2441	$2352	$2411	$2602	$2586	$3174
	10-Year Total Cost of Ownership rates	$59,074	$45,423	$35,792	$41,299	$42,585	$38,092	$38,928	$43,424	$43,716	$49,400

The analysis does not incorporate inflation or discount rates, meaning that future operating costs are not adjusted over time to reflect changes in electricity prices or the time value of money. Costs are presented in nominal terms to allow straightforward comparison across scenarios. All scenarios were evaluated using a consistent set of assumptions to provide directional insight into cost differences and trade-offs among alternatives. Accordingly, the team designed the research to highlight the comparative advantages and limitations of different electrification pathways rather than to identify or recommend a single best scenario for any particular household.

Figure 3 and Figure 4 present the upfront costs and 10-year operating cost estimates for the top ten electrification scenarios under two representative climate conditions. Figure 3 summarizes results for the colder climate, while Figure 4 summarizes results for the hotter climate. Upfront costs include equipment, installation, electrician labor, and any required electrical upgrades. Operating costs reflect modeled electricity consumption for space heating and cooling, water heating, clothes drying, and cooking over a 10-year period and are presented in nominal terms. Together, these tables support comparison of total cost of ownership and highlight relative cost tradeoffs across electrification pathways and climate conditions.

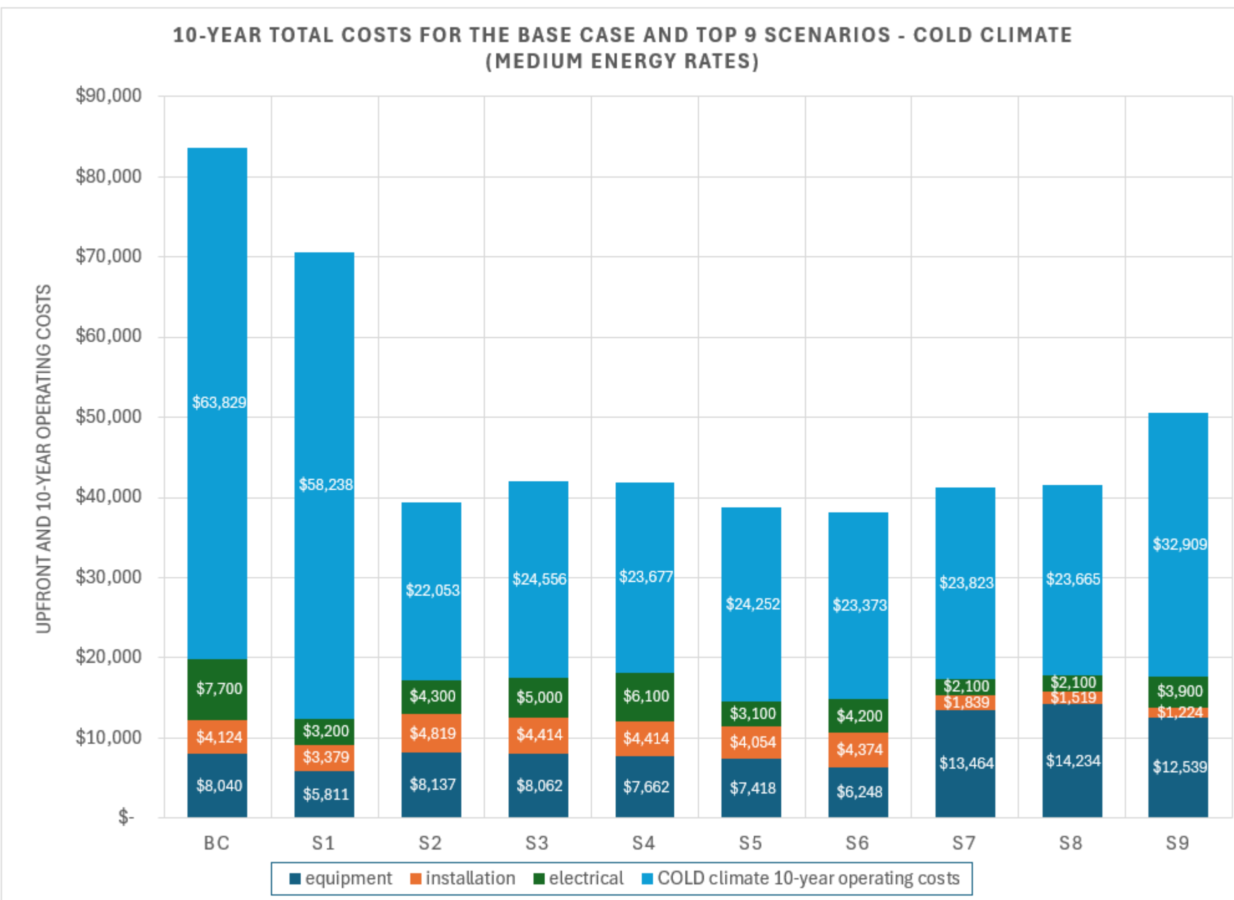

Figure 3: Top ten scenarios – upfront and 10-year operating costs: cold climate.

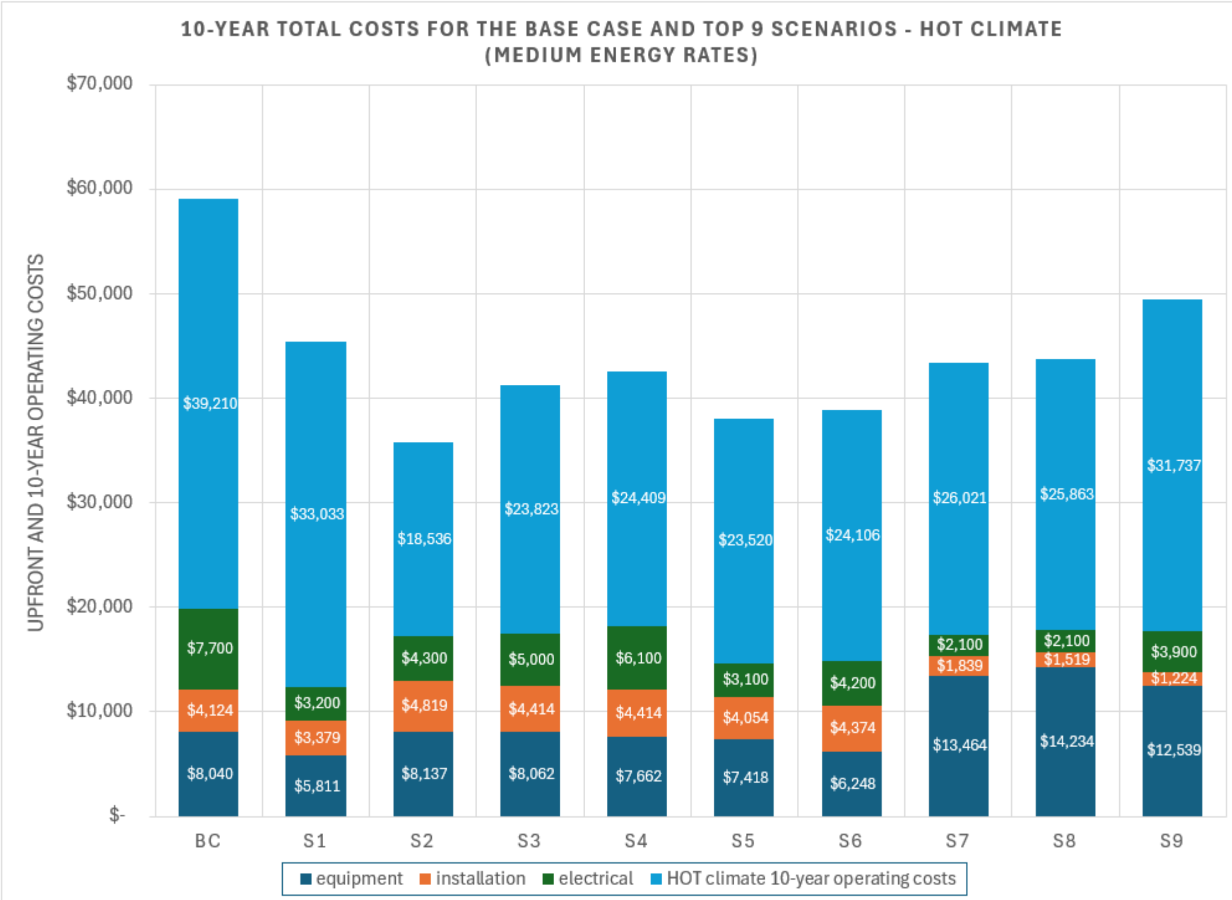

Figure 4: Top ten scenarios – upfront and 10-year operating costs: hot climate.

Electrification Scenarios: Down-Selection to the Top Five

The team removed four scenarios during the down-selection because they offered fewer advantages, had higher costs, or did not meet key requirements.

- **Scenario 1:** Removed because its reliance on electric resistance heating leads to higher operating costs.
- **Scenario 4**: Closely mirrors Scenario 3 but did not pass the manufactured-home electrical load calculation, so it was not advanced.
- **Scenario 8**: Nearly identical to Scenario 7, but it substitutes a heat pump dryer; because heat pump dryer savings are relatively small and performance is generally worse than a standard electric dryer, Scenario 7 was prioritized.
- **Scenario 9:** Eliminated for similar reasons to Scenario 1, since it depends on electric resistance appliances for the water heater, clothes dryer, and cooking range.

This down-selection left five scenarios with the best overall balance of cost, performance, and code compliance. Following the evaluation of the top ten electrification scenarios, the team advanced five scenarios for more detailed comparison based on their balance of cost, performance, user experience, and electrical code compliance. Table 14 summarizes the base electrification case and these five selected scenarios, including the appliance packages and control approaches used and the resulting electrical loads under the MH 527, NEC standard, and NEC optional load calculation methods.

Table 14: Base and top five scenarios.

Scenario	Efficient Appliances	Controls	MH 527 Load Calc	Standard Load Calc	Optional Load Calc
Base Electrification	None. All electric resistance appliances	Smart panel (numbers to the right are the loads if the smart panel was not installed)	170.2 A (fail)	163.4 A (fail)	110.5 A (fail)
S2 – All Heat Pump	Multi-zone ductless heat pump, 120 V HPWH, washer/HP dryer combo	None	82.7 A	94.0 A	68.4 A
S3 – Smart Switch	Centrally ducted heat pump, 120 V HPWH	Smart circuit switch (dryer)	77.9 A	73.2 A	67.0 A
S5 – Two Low-Power Devices	Centrally ducted heat pump, 120 V HPWH, 120 V induction range	None	55.1 A	72.0 A	57.4 A
S6 – One Low-Power	Centrally ducted heat pump, 240 V Hybrid HPWH, 120 V induction range	None	104.8 A (fail)	96.8 A	74.3 A
S7 – Window Heat Pump	Window-mount heat pumps, 120 V HPWH	None	95.3 A	90.6 A	72.8 A

The five electrification scenarios described above were chosen based on cost, both upfront and recurring energy costs, and compliance with the electrical load calculation requirements of the relevant code (either NEC or California manufactured housing rules). All five scenarios have similar 10-year total costs but use different combinations of appliances and controls; the team selected them for deeper analysis of directional TSB impacts and user experience.

Total System Benefits

TSB results are presented using a directional screening approach rather than a quantified benefit cost analysis. The team evaluated each appliance relative to its counterpart in the base electrification scenario to assess whether it was expected to increase or decrease TSB across five avoided-cost dimensions: energy, generation capacity, transmission, and distribution capacity, ancillary services, and refrigerants. Directional scores reflecting these considerations were assigned to each appliance included in the top five scenarios. As outlined in the Methodology & Approach section, each constituent appliance received a rating of -1 (worse), 0 (neutral) or 1 (positive) across each of the five avoided-cost dimensions to provide a total score (ranging from -5 to 5). Results are summarized in Table 15; each technology was compared against the corresponding base electrification scenario appliance, which is referred to as the comparison appliance.

Table 15: TSB considerations for the appliances featured in the top five scenarios.

Technology	Score	Comparison Appliance	Energy (Annual kWh)	Generation Capacity (Load Shifting)	Ancillary Services (Demand Response)	Transmission & Distribution (Power Efficiency)	High-GWP Gases & GHGs (Refrigerants)
A1.1 120 V Induction Cooking Ranges	2	240 V electric range with a 4-burner radiant cooktop	Slightly **positive** due to reduced standby and efficient induction cooking compared to conventional electric ranges	Neutral; no load shifting advantage over electric range	Neutral; no integrated demand response capability	**Positive** by easing service and feeder constraints, supporting electrification without upgrades	Neutral; no refrigerants
A2.1 Heat Pump Clothes Dryers	1	240 V vented electric resistance dryer	**Positive** due to significantly lower energy use vs. resistance dryers	Neutral; no load shifting advantage over electric dryer	Neutral; no integrated demand response capability	**Positive** by reducing branch and service-level peak loads	**Negative** due to high GWP refrigerants used in appliance
A2.2 Washer/Heat Pump (HP) Dryer Combo Units	1	Separate washer and electric resistance clothes dryer	**Positive** due to efficient heat pump drying and reduced redundant losses	Neutral; no load shifting advantage over separate washer and electric dryer	Neutral; no integrated demand response capability	**Positive** by eliminating 240 V circuits and reducing service load	**Negative** due to high GWP refrigerants used in appliance
A3.1 120 V Heat Pump Water Heaters	1	Electric resistance water heater	**Positive** due to high efficiency vs. resistance water heating	Neutral; no load shifting advantage over electric resistance water heater	Neutral; no integrated demand response capability	**Positive** by avoiding panel and feeder upgrades	**Negative** due to high GWP refrigerants used in appliance
A3.4 240 V Heat Pump Water Heaters	0	Electric resistance water heater	**Positive**; highest efficiency water heating option	Neutral; no load shifting advantage over electric resistance	Neutral; no integrated demand response capability	Neutral; same 240 V circuit requirements	**Negative** due to high GWP refrigerants used in appliance

				water heater.			
A4 High-Efficiency Heat Pump Space Conditioning	3	Electric resistance furnace and window ACs	**Positive** due to high efficiency vs. resistance electric furnace for heating and window units for cooling	**Positive** due to reduced peak demand	Neutral; no integrated demand response capability	**Positive;** more power-efficient than comparison	Neutral; no refrigerants
Smart Panel	2	200 amp service upgrade	Neutral, no impact on energy efficiency	Neutral; no inherent load shifting ability (only shedding)	**Positive;** integrated demand response possible albeit nascent	**Positive;** more power-efficient than comparison	Neutral; no refrigerants

All five leading scenarios show a net positive directional TSB impact relative to the base electrification case (score = 2), which includes an electric furnace, electric resistance water heater, electric stove, electric dryer, and a smart panel. TSB scores are driven by appliance efficiency, peak load characteristics, energy storage capability, and refrigerant type and leak potential. Scenario scores range from seven points (Scenario 5) to four points (Scenario 3), as summarized in Table 16. The scenarios are presented below in order of estimated TSB avoided cost, from highest to lowest.

Table 16: TSB scoring summary for the top five scenarios.

Scenario	TSB Score	Heating and Cooling	Hot Water	Cooking	Dryer	Controls
Base Electrification Case	2	Electric furnace	Electric resistance water heater	Electric stove	Electric dryer	Smart panel
S5	7	3: Ducted HP	1: 120 V HPWH	2: 120 V induction range	1: HP dryer	N/A: None
S2	5	3: Ductless HP	1: 120 V HPWH	0: Elec range	1: Washer and drier combo	N/A: None
S6	5	3: Ducted HP	0: HPWH	2: 120 V induction range	0: Elec dryer	N/A: None
S7	4	3: Window HPs	1: 120 V HPWH	0: Elec range	0: Elec dryer	N/A: None
S3	4	3: Ducted HP	1: 120 V HPWH	0: Elec range	0: Elec dryer	N/A: Smart circuit switch

User Experience Characterization

The team evaluated the user experience for each electrification scenario relative to the base electrification scenario, which is summarized in Table 17. Each appliance lists a range of expected positive and negative experiences due to variations in form factors (weight and space), performance and associated user behavior changes required (for example, the time to complete a load of laundry). Qualitative user experience will vary based on household preferences, usage patterns, and tolerance for trade-offs, but an overall rating is characterized as one of four qualitative user experience outcomes: positive, neutral, minor inconvenience, and inconvenience. Furthermore, it's important to acknowledge tradeoffs can vary by household composition (e.g., seniors, large families, medically vulnerable residents, work-from-home households). The qualitative descriptions below are intended to illustrate a range of considerations rather than prescribe specific choices. Final decisions should be made by the relative advantages and limitations of each appliance in the context of existing equipment, home characteristics, and budget constraints.

Table 17: User experience considerations for the appliances featured in the top five scenarios.

Technology	S6	S3	S7	S5	S2	Comparison	Experience	Qualitative Characterization of User Experience
Ducted and Ductless Heat Pumps (HPs)	x	x		x		Electric furnace and window A/Cs	Positive	Positive: Improved cooling performance and better temperature control. Negative: Some models require periodic filter cleaning.
Window Heat Pumps			x			Electric furnace and window A/Cs	Neutral	Positive: Improved cooling compared to conventional window A/Cs. Negative: No centralized control; room-by-room adjustment impact comfort. Can impact interior space.
240 V Heat Pump Water Heater (HPWH)	x					Electric (resistance) water heater	Minor Inconvenience	Positive: May provide some cooling. Negative: Can be noisier than resistance units; requires filter cleaning that may be hard to access.
Heat Pump Dryer						Electric (resistance) dryer	Minor Inconvenience	Positive: Gentler drying may extend clothing life; no outdoor venting reduces air infiltration. Negative: Often longer cycle times; some models have smaller capacity; require filter cleaning.
120 V Induction Range	x		x	x	x	Electric (resistance) Range	Minor Inconvenience	Positive: Faster boiling and lower burn risk than resistance cooking. Negative: Fewer burners, longer oven preheat times and require induction compatible cookware.
Smart Circuit Switch						No controls	Minor Inconvenience	Negative: May occasionally interrupt appliance operation, though this is expected to be rare.
Smart Panel						No controls	Inconvenience	Negative: May intermittently curtail loads to stay within service limits, depending on usage patterns.
120 V Heat Pump Water Heater (HPWH)		x				Electric (resistance) water heater	Inconvenience	Positive: May provide some dehumidification. Negative: Slower recovery and lower capacity may affect high-use households; potential noise and filter access challenges.
Washer and Dryer Combo Appliance					x	Standalone washer and electric dryer	Inconvenience	Positive: No load transfer required; compact design can free up space; no outdoor venting reduces air infiltration.

							Negative: Smaller capacity and longer cycle times may not suit high-laundry households.

Each of the top scenarios includes a mix of high-efficiency and conventional appliances. Table 17 above identifies the specific power efficient technologies included in each scenario and summarizes the overall user experience impact associated with the technologies in each package. Overall, several scenarios result in only minor inconvenience and are likely to be acceptable to most households. Scenario S6 provides a comparatively balanced experience. A ducted heat pump improves comfort relative to resistance heating, while the HPWH and 120 V induction range introduce modest tradeoffs related to hot water recovery and cooking flexibility. S6 uses an electric dryer like the base scenario so the user experience is identical for that appliance; Scenario S3 also falls into this category, pairing a ducted heat pump with a 120 V HPWH and a smart circuit switch. While occasional curtailment and slightly reduced hot water recovery may occur, improvements in space heating and cooling performance largely offset these impacts for many households.

Other scenarios involve more significant changes to appliance performance and day-to-day use and should be considered more carefully to ensure they are a good fit. Scenario S7 relies on window HPs, which can limit centralized control and whole home comfort management, and includes a 120 V HPWH that may constrain hot water availability during periods of high demand. Scenario S5 combines a ducted HP with multiple low-power appliances, resulting in reduced hot water capacity, cooking limitations associated with a 120 V induction range, and longer drying times from an HP dryer. Scenario S2 features ductless HPs that provide strong zoning benefits, but it pairs them with a 120 V HPWH and a washer/dryer combo, which may require behavioral adjustments due to slower recovery times, smaller capacity, and longer operating cycles. These scenarios may still be attractive for some households, but the cumulative impact on user experience warrants closer alignment with household needs, preferences, and tolerance for tradeoffs.

Stakeholder Insights on Electrification in Manufactured Housing

The technical analysis was complemented by stakeholder interviews, conducted both in person and via phone, focused on understanding what is required for electrification to succeed in MMHs. Interviews engaged manufactured home residents, contractors, and community stakeholders, including CBOs experienced in supporting electrification efforts in California.

Interviewees generally viewed electrification in manufactured housing as technically feasible and, in many cases, desirable. However, progress was consistently described as constrained by affordability, infrastructure limitations, and programmatic barriers rather than by limitations in available technologies. Interviewees characterized electrification as a system-level challenge that requires coordination across utilities, programs, contractors, regulators, and residents, rather than a straightforward appliance replacement process. Stakeholders emphasized that fragmented responsibilities and misaligned incentives often slow or derail projects even when technical solutions are available.

A central theme was the misalignment between program design and real-world MMH conditions, with stakeholders describing existing programs as rigid and prescriptive. They also noted that program requirements are often structured around standardized scopes of work and “ready-to-install” assumptions, which do not reflect the variability of manufactured home conditions. For example, this can create challenges when projects require sequencing (e.g., electrical remediation prior to equipment installation) or site-specific adaptations. While stakeholders did not collectively identify a single program, this feedback reflected a broader perception across utility- and state-administered programs. Contractors and CBOs stressed that successful electrification depends on flexibility, site-specific decision-making, and the ability to adapt as conditions are uncovered in the field. Programs that do not accommodate variability in electrical condition, layout, ownership structure, or sequencing needs were viewed as creating barriers to both participation and implementation.

Many stakeholders emphasized that electrification in MMH typically requires substantial pre-work before electric equipment can be installed. Homes often need electrical repairs, safety remediation, wiring upgrades, or general stabilization as an initial step. Interviewees stressed that electrification should be framed as a multi-step process rather than a single equipment swap. Failure to acknowledge sequencing requirements was reported to lead to cost overruns, delays, and friction with contractors and programs. Stakeholders also highlighted the importance of setting realistic expectations early in the process to avoid project failure or abandonment.

A widely cited barrier was the persistent belief that electrification requires a 200-amp service panel, a belief described as both a financial and psychological barrier that discourages residents and contractors from pursuing electrification opportunities. Interviewees emphasized the need for consistent messaging and clear guidance to correct this narrative and clarify feasible electrification pathways. This feedback reinforces the need for clear, accessible guidance that demonstrates viable pathways within 100-amp constraints.

Affordability emerged as the dominant barrier to adoption. Residents were described as highly sensitive to upfront costs and more likely to prioritize the lowest immediate expense over long-term savings. Even replacement with a like-for-like appliance frequently presented a financial burden for residents, and electrification readiness costs added further complexity. Electrical work, permitting, inspections, utility coordination, and professional labor collectively made projects expensive and difficult to navigate.

Stakeholders also emphasized that a lack of awareness, rather than resistance, limits adoption. Electrification was not described as a common topic of conversation among residents, and many lacked familiarities with available technologies or their benefits. Contractors similarly reported knowledge gaps related to right-sizing equipment and working within 100-amp constraints. Trusted social networks were identified as critical channels for decision-making, with residents relying heavily on contractors, neighbors, family members, and community maintenance staff. Interviewees shared that leveraging these trusted intermediaries is essential for effective engagement, particularly in communities facing structural barriers, such as master metering and shared infrastructure constraints. Program design is the primary barrier to electrification in manufactured housing.

Key Takeaways

Electrification is Feasible on 100-Amp Service

Manufactured homes can achieve full electrification on 100-amp service by using efficient and low power appliances, supplemented in some cases by smart controls. Smart panels paired with low-cost appliances, such as electric furnaces, maintain compliance with a 100-amp service limit by actively curtailing demand. However, the roughly $7,500 installed cost of a smart panel, combined with the high operating costs of electric resistance appliances, can eliminate the apparent savings associated with lower upfront equipment costs. When low-power, high-efficiency appliances are selected, a smart electrical panel is often unnecessary.

Extreme Power Efficiency is Not Required

The two extremes of the analysis are a whole-home EMS, with no effort to minimize the demand of any of the end uses, and pure 120 V power-efficient appliances to minimize demand at every appliance. As demonstrated by the ten scenarios evaluated for 10-year costs, full electrification within the 100-amp boundary does not require either of the extremes. That leaves flexibility for a homeowner to identify which qualitative impacts are acceptable and assemble an electrification package accordingly to avoid unacceptable impacts.

Heat Pump Energy Efficiency Also Delivers Power Efficiency

The advantage of the electrical load calculations of heat pumps (HPs), whether space heating, water heating or clothes drying, is significant, allowing flexibility in assembling the remainder of the package with higher power demand appliances such as the cooking range or electric resistance clothes dryer. At the same time, HPs have a large beneficial effect on operating costs, driving the substantial difference in 10-year costs between the base case electrification scenario and all of the top five electrification scenarios.

10-Year Costs Are Operations-Dominated

This research accounts for material and labor costs associated with making changes to the electrical infrastructure within the manufactured home, including panel replacement or alteration, new circuit wiring, load controls and replacement appliances. Over time, the accumulated costs of operating the space conditioning, water heater, clothes dryer, and cooking range grows to exceed the capital costs of electrifying a home that starts with all gas appliances. Among the ten scenarios for which operating costs were determined, using a mid-range future electric rate, over ten years the operational costs range from 52 percent to 73 percent of total costs. This highlights the benefits of energy efficiency as well as power efficiency, and points to the important role of electric rates in making electrification accessible to all Californians. Higher than projected rates will further advantage homes with efficient appliances and dwarf the first costs of electrification.

Some User Impact is Inevitable

Many approaches to electrification on 100-amp service rely on technologies that reduce both energy use and peak power demand. Compared to gas or electric resistance equipment, heat pumps and other low-power technologies can result in a noticeably different user experience. For example, an HP clothes dryer may take longer to dry a load of laundry. Other changes may be perceived as benefits, such as quieter and more even heat compared to a gas furnace. Successfully adopting the electrification strategies outlined in this report requires an understanding of these trade-offs and a willingness to adapt to the operational differences associated with low-power and high-efficiency technologies.

IPMTs Have a Role in Manufactured Home Electrification

The research team found that among IPMT options, smart circuit switches offer a practical and cost-effective load management strategy by actively controlling or shedding specific loads. These technologies can reduce total calculated electrical demand and enable new electrification measures without a service upgrade and without the expense of a smart panel. However, because HCD and MH 527 are silent on EMSes, electricians may be unwilling to develop a project based on a technology with an uncertain path to approval. Further demonstration projects that raise awareness of EMSes with electricians and outreach to HCD for code clarification would be beneficial.

Code Takeaways

The team reviewed manufactured home load calculation requirements in California, including the distinction between manufactured homes (post-1976) and mobile homes (pre-1976), both of which fall under the jurisdiction of the HCD and require use of form MH 527 for electrical load calculations. While state law is clear on this requirement, the research team and partners are aware of multiple manufactured home projects in which local code officials have instead applied NEC load calculation methods.

Both MH 527 and NEC load calculation methods are conservative, with the standard NEC method and MH 527 being more conservative than the NEC optional method. In this context, "conservative" means that the maximum electrical load resulting from the load calculations is likely much higher than the maximum load a home will experience. Metered data confirm this, showing that one-year maximum total loads are typically much lower than calculated values. The NEC permits the use of measured maximum electrical load as the starting point for a load calculation under Section 220.87.

The MH 527 load calculation makes no mention of basing an electrical load calculation on metered data and does not address the use of EMSes (such as smart panels or smart controls), which are allowed by the NEC under section 220.70. However, the California statute governing manufactured homes incorporates external standards through 24 CFR 3280.4, and that section explicitly adopts the NEC by reference. The MH 527 load calculation method is also a near verbatim copy of the NEC's standard load calculation approach, which strongly implies that other NEC provisions, including 220.70 (energy management systems) and 220.87 (measurement-based load calculations), would apply to manufactured homes. But because MH 527 does not mention these options, and HCD has not clarified how NEC incorporated provisions interact with the form, it remains uncertain whether electricians working on manufactured or mobile homes can rely on those options.

Additional constraints within the NEC further limit the recognition of modern, efficient appliances. An example is the standard load calculation requirement to assume a minimum 5,000-watt dryer load regardless of the installed equipment, which effectively negates the load reduction benefits of heat pump dryers. This requirement does not apply under the NEC optional method or MH 527.

Guidance Document to Guide Homeowners

Manufactured home electrification faces a set of practical needs tied to electrical constraints, cost, and project complexity. Homeowners often assume electrification requires expensive panel or service upgrades, particularly in homes with 100-amp service, and may not realize there are viable lower-power pathways. They also need clear, easy-to-use information on which electric appliances can work within typical manufactured home limits, what performance tradeoffs to expect, and what basic feasibility checks to complete before selecting equipment. Finally, homeowners and trade allies need a consistent set of questions and decision points to support contractor conversations, coordinate electricians, plumbers, and HVAC contractors, and sequence upgrades over time without rework.

The guidance attached in Appendix D offers practical manufactured-home-specific direction that helps households electrify one appliance at a time while planning toward a fully electric home. It highlights affordable technologies that can often avoid electrical upgrades, including 120 V plug-in options and smart circuit switches that can manage loads and prevent overloads on constrained service. The guidance also emphasizes planning ahead with the right team and provides prompts to use with electricians, plumbers, HVAC contractors, utilities, and park managers so homeowners can assess feasibility, right-size equipment, and identify available incentives before committing to major work.

Current Market Barriers and Gaps

Electrification of manufactured homes with 100-amp service is technically feasible, but several market barriers and emerging opportunities continue to shape adoption pathways. Key considerations include:

- Limited market for low-power options
- High equipment costs
- Performance trade-offs
- Housing variability
- Limited contractor and homeowner awareness

While electrification of manufactured homes with 100-amp service is feasible, the market for low-power devices remains limited, and in some cases, equipment costs are high enough to erode the benefits of avoiding electrical upgrades. Technology choices therefore require careful evaluation of both upfront and long-term value. Battery-integrated cooking ranges can support code compliance by reducing peak electrical demand. However, they do not materially reduce annual energy use, and their high equipment costs often make them a weaker investment than alternatives, such as heat pumps and heat pump water heaters, which reduce both peak load and ongoing operating costs.

Some 120 V appliances also remain expensive relative to their performance and can require meaningful user trade-offs. For example, standalone 120 V heat pump clothes dryers are often less attractive than 240 V heat pump dryers, which this analysis shows are only modestly more expensive to install, on the order of tens of dollars, while offering better efficiency and larger capacity. Even so, some households may still choose 120 V options to avoid electrical work or because a 240 V circuit is not feasible. Because there are currently few 120 V standalone dryers on the market, both costs and user experience could improve as additional models become available and competition increases.

Manufactured and mobile homes vary widely in layout, age, existing equipment, climate, and electrical configuration, making a rigid, step-by-step electrification prescriptive pathway neither realistic nor advisable. This variability increases the value of clearly articulated guiding principles that help homeowners and contractors make informed decisions within specific constraints. Foundational principles include understanding actual electrical load relative to service rating, prioritizing end uses that deliver the greatest comfort or cost savings, selecting power-efficient and 120-volt appliances where appropriate, and sequencing upgrades to avoid rework. Shifting from one-size-fits-all instructions to practical, principle-based guidance allows residents to pursue feasible electrification pathways while retaining flexibility for site specific solutions.

Although electrification of a manufactured home with 100-amp service is achievable, pathways to widespread adoption are still emerging. Many technologies that enable low-power electrification are relatively new and not yet well understood by homeowners or contractors. Increased awareness, specialized contractor expertise, and business models tailored to manufactured home electrification are needed to scale adoption. The combined equipment and installation costs of replacing gas appliances remain a significant barrier that cannot be fully mitigated through informed technology selection alone. Targeted incentives and financing options will be necessary to make electrification broadly accessible to this housing stock. Finally, low-power electrification may require adjustments to user expectations, making it important to pair information about performance trade-offs with a clear articulation of benefits to support transparent and realistic decision-making.

Market Opportunities

Demand is growing for 120 V appliances, load managed electrification packages, and retrofit friendly solutions that reduce total installed cost while maintaining performance. These segments are well positioned for growth as consumers, utilities, and programs seek pathways to electrification that minimize disruption, reduce upfront costs, and avoid full panel or service upgrades.

A significant near-term market opportunity lies in the development of specialized low power electrification contracting services tailored to manufactured homes. While the market for low power and 120-volt appliances is still emerging, the findings of this study suggest that a knowledgeable contractor base may unlock adoption more effectively than continued proliferation of niche devices alone. Contractors with expertise in manufactured housing conditions, HCD permitting requirements, MH 527 load calculation pathways, and common electrification scenarios are well positioned to deliver integrated solutions that remain within 100-amp service limits. Additionally, contractors specializing in manufactured home electrification can engender trust by working locally and developing solutions specific to the building type. Stakeholders cited the importance of neighbor references and local credentials for contractor selection.

Manufactured home electrification specialists will develop familiarity with current product availability, installation tradeoffs, and observed customer experience with low power technologies reducing project risk, streamlining permitting, and building homeowner confidence. A service-oriented electrification model that combines appliance selection, load management, and project sequencing offers a scalable pathway to electrifying this housing stock and represents a meaningful opportunity for contractors, program implementers, and service providers.

Several converging trends are contributing to these opportunities. Continued improvements in appliance efficiency, expanded availability of 120 V and low-power equipment, and declining hardware costs are lowering barriers to adoption. At the same time, advances in load management technologies are making it increasingly feasible to electrify a 100‑amp service. More sophisticated panel-level controls, smart circuit switches, and integrated control platforms are improving reliability and user experience, reducing the tradeoffs faced by early adopters and increasing confidence among installers and regulators.

Emerging technologies are also creating new competitive niches focused on improving TSB and overall customer experience. Battery-integrated appliances represent a particularly promising segment, offering a “no-regrets” approach that decouples when energy is drawn from the grid from when it is used in the home. By flattening peak power demands, these systems can avoid or defer service upsizing while preserving appliance performance and customer convenience. In parallel, grid-connected smart appliances that automatically respond to price signals or grid conditions can reduce operating costs for customers while delivering demand flexibility and reliability benefits to utilities.

The competitive landscape remains relatively open, with room for new entrants and differentiated offerings. While established manufacturers dominate traditional appliance categories, fewer players are fully integrated across appliances, controls, and grid connectivity. This creates opportunities for emerging technology developers, system integrators, and manufacturers that can deliver coordinated solutions rather than standalone products. Broader acceptance by AHJs of code-compliant load management approaches would further accelerate market growth by reducing permitting uncertainty and enabling lower-cost alternatives to conventional service upgrades. Together, these dynamics position managed electrification technologies as a high-growth area with meaningful opportunities for innovation, investment, and scale.

Recommendations

The findings from this study demonstrate that full electrification of manufactured homes on 100-amp electrical service is feasible today using a range of power-efficient appliances, low power technologies, and targeted load management strategies. Based on this research and analysis, the following recommendations are offered to support near-term adoption and longer-term market development.

Empower Homeowners with Information and Guidance

Many manufactured homeowners believe their homes are not candidates for electrification. This study shows there are multiple viable pathways to electrification within existing 100-amp service constraints. Program administrators, utilities, and community partners should engage in proactive outreach and education that highlights low power alternatives. Low power appliances, automated sequencing strategies, selective load management, and whole home smart control need to be packaged into homeowner-friendly guidance documents that can be shared through multiple channels, especially those focusing on manufactured home parks. Easy-to-digest resources should be developed to help homeowners understand basic feasibility checks, compare electrification options, anticipate performance trade-offs, and structure productive conversations with electricians, plumbers, and HVAC contractors. Such guidance should support phased electrification approaches, helping households plan upgrades over time without rework while matching solutions to comfort, cost, and capacity constraints.

A future research project should aggregate existing expertise on serving manufactured homeowners to create electrification guidance assets suitable to platforms where homeowners commonly learn about services for their homes.

Engage AHJs to Clarify Load Calculation Pathways for Manufactured Homes

Ambiguities in how MH 527 applies to modern electrification technologies remain a barrier to consistent project implementation. Continued engagement with AHJs, state agencies, and other regulatory stakeholders is recommended to clarify how power-efficient appliances and smart load management technologies can be accounted for in manufactured home load calculations. Improved guidance and consistency across jurisdictions would reduce permitting uncertainty, increase contractor confidence, and help avoid unnecessary electrical upgrades that add cost without improving safety. Demonstration electrification projects in manufactured homes are recommended to uncover permitting barriers and opportunities for streamlining technology approvals.

Invest in Contractor Education and Specialization for Manufactured Home Electrification

Successful electrification of manufactured homes depends not only on available technologies but also on contractor familiarity with power-efficient design, MH 527 requirements, and the performance tradeoffs associated with low power solutions. Many of the technologies evaluated in this study are relatively new and remain unfamiliar to electricians, HVAC contractors, and plumbers who typically serve this housing stock. Targeted training, education, and technical assistance can help build a specialized contractor base with expertise in manufactured home electrification, including load calculations, appliance selection, permitting pathways, and sequencing of upgrades. Supporting this specialization would improve project outcomes, reduce unnecessary upgrades, and increase confidence among homeowners, contractors, and AHJs. A research project is recommended to discover the most effective ways to build specialization in manufactured housing electrification among electricians and contractors.

Support Continued Testing and Application of Power-Efficient Electrification Technologies as Appropriate

Ongoing technology innovation is essential to expanding the set of viable electrification options for service-constrained homes. Future development should prioritize devices that simultaneously advance power efficiency, energy efficiency, user experience, and TSB. Emphasis should be placed on reducing peak electrical demand without introducing unnecessary user inconvenience, improving appliance performance at low power levels, and adopting low-GWP refrigerants and grid-interactive features. Targeted research into optimal use cases and customer convenience for smart panels, demonstration of underutilized technologies like room heat pumps and 120 V induction ranges, and early market support for several of the technologies described here can help accelerate cost reductions and performance improvements in these emerging product categories.

Together, these recommendations aim to translate the technical feasibility demonstrated in this study into practical, scalable electrification pathways for manufactured homes. By pairing homeowner awareness, technology advancement, regulatory clarity, and accessible guidance, stakeholders can reduce barriers to adoption and accelerate equitable electrification in this service-constrained housing stock.

References

Association, National Fire Protection. n.d. *California Electrical Code Updates.* Accessed 2026. https://www.nfpa.org/forms/ca-electrical-code-updates.

Baranow, Natasha, Nick Neverisky, Brian Picariello, Christine White, Irina Krishpinovich, Alex Pine, Ben Staub, Myriam Tourneux, and Stefan Haener. 2023. "Market Study of Household Electric Infrastructure Upgrades."

2025. *CA Health & Safety Code § 18007.* Accessed 2026. https://law.justia.com/codes/california/code-hsc/division-13/part-2/chapter-1/section-18007/.

2025. *CA Health & Safety Code § 18008.* https://law.justia.com/codes/california/code-hsc/division-13/part-2/chapter-1/section-18008/.

2025. *CA Health & Safety Code § 19971.* Accessed 2026. https://law.justia.com/codes/california/code-hsc/division-13/part-6/chapter-2/section-19971/.

n.d. *CalNEXT.* Accessed 10 18, 2023. https://calnext.com/.

CalNEXT. n.d. Accessed 2025. https://calnext.com/wp-content/uploads/2024/10/Individual-Home-Decision-Tool.xlsx.

ConnectDER. n.d. "EV Meter Socket Adapter." *ConnectDER.* Accessed 11 3, 2025. https://connectder.com/wp-content/uploads/2024/03/ConnectDER-EV_MSA_V1.0-Technical_Specifications.pdf.

Copper. n.d. *Charlie.* Accessed 11 2, 2025. https://copperhome.com/products/charlie.

Development, California Department of Housing and Community. n.d. *Manufactured & Mobilehomes Modifications and Alterations.* Accessed 2026. https://www.hcd.ca.gov/manufactured-and-mobilehomes/modifying-mobilehome.

n.d. *DIVVEE-60 Energy Management System.* Accessed 11 3, 2025. https://www.loadsharetechnologies.com/divvee-60/.

Electra. n.d. *Electria 30" Induction Stove.* Accessed 11 3, 2025. https://www.electra.com/product-specs.

FSEC. 2016. "Measured Performance of Heat Pump Clothes Dryer." ACEEE.

n.d. "HCD Permit Requirements - Alterations or Conversions ." *Western Manufactured Housing Communities Association.* Accessed 11 3, 2025. https://www.wma.org/sites/main/files/file-attachments/permits_required.pdf?1691440439.

Holt, Mike. n.d. *Mike Holt Enterprises.* Accessed 11 3, 2025. https://www.mikeholt.com/electrician-toolbox-home.php.

International Code Council. 2022. "ANSI/RESNET/ICC 301-2022 Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index."

Kaestner, Nik. n.d. *Getting Off Gas Without an Electric Upgrade.* Accessed 2026. https://aoausa.com/getting-off-gas-without-an-electric-upgrade-by-nik-kaestner/.

Kane, Mark. 2024. *ConnectDER EV Meter Socket Adapter: Simple Charging Solution for Homes With Limited Power.* Accessed 11 3, 2025. https://evchargingstations.com/chargingnews/connectder-ev-meter-socket-adapter/.

Less, Brennan D., and Iain S. Walker. 2026. "Characterizing Peak Electricity Demand for U.S. Households: An Assessment of End-Use Loads and Demand Factors." *Applied Energy.*

n.d. *Loadshare 60A High Capacity Loadshare Device, NEMA 1, 208-240 VAC.* Accessed 11 3, 2025. https://ebhorsman.com/divvee-60.html.

n.d. *Lumin ABB Smart Electrical Panel Indoor.* Accessed 11 3, 2025. https://www.renvu.com/products/lumin-abb-smart-electrical-panel-indoor.

LuminSmart. n.d. *Lumin Smart Panel Technical Specifications.* Accessed 11 3, 2025. https://www.luminsmart.com/storage/app/media/Lumin%20lsp/Spec%20Sheets/Lumin%20Smart%20Panel%20Full%20Tech%20Specs%20Indoor%2010.31.pdf.

n.d. "Manufactured Home Electrical Load Worksheet." *State of California.* Accessed 11 3, 2025. https://www.hcd.ca.gov/sites/default/files/docs/manufactured-and-mobilehomes/hcd-mh-527.pdf.

NEEA. 2017. "Clothing Wear and Tear of Heat Pump vs. Electric Resistance Clothes Dryers ."

n.d. *NEMA 10-50 Smart Splitter - EV/Appliance.* Accessed 11 3, 2025. https://getneocharge.com/products/nema-10-50.

n.d. *NeoCharge Smart Splitter.* Accessed 11 3, 2025. https://getneocharge.com/products/neocharge-smart-splitter?variant=41851548008643.

NFPA. n.d. *NFPA Electrical Code Updates.* Accessed 11 3, 2025. https://www.nfpa.org/forms/ca-electrical-code-updates.

—. n.d. *NFPA Publications.* Accessed 11 3, 2025. https://link.nfpa.org/free-access/publications/70/2023.

2026. *PART 3280—MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS.* Accessed 2026. https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280.

n.d. *Redwood Energy.* Accessed 11 3, 2025. https://www.redwoodenergy.net/watt-diet-calculator.

Redwood Energy. 2022. *Retrofit Ready Induction Stove.* Accessed 11 3, 2025. https://www.redwoodenergy.net/research/retrofit-ready-induction-stove.

Regulations, Code of Federal. n.d. *PART 3280—MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS.* Accessed 2026. https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280.

RHA. 2024. *Electric Service Optimization for Building Officials.* 5 12. Accessed 11 3, 2025. https://svcleanenergy.org/wp-content/uploads/Service-Optimization-Guide-Building-Officials-Extended.pdf.

n.d. *SPAN Panel Main 40.* Accessed 11 3, 2025. https://www.span.io/products/main-40.

SPAN. n.d. *SPAN Edge Intelligent Service Point.* Accessed 11 3, 2025. https://www.span.io/products/edge.

TRC. 2024. "Residential Electrical Service Upgrade Decision Tool Final Report."

VEIC. 2023. "Market Study of Household Electric Infrastructure Upgrade Alternatives for Electrification."

VEIC. 2023. "Mobile and Manufactured Housing Market Characterization Study Final Report."

Walker, Iain S. 2025. *Stakeholder Meeting with Residential Building System Group, Building Technology and Urban Systems Division, Lawrence Berkeley National Laboratory* (10 13).

Whirlpool. n.d. *Damp Clothing - Compact Heat Pump Dryer.* Accessed 2026.

https://producthelp.whirlpool.com/Laundry/Dryers/Compact_Heat_Pump_Dryer/Drying_Performance/Damp_Clothing/Damp_Clothing_-_Compact_Heat_Pump_Dryer.

Appendix A: Energy Modeling Supplemental Information

The interactive effects of electrification measures were captured by the energy modeling software, REM/Rate v 2025. In particular, the transition to ductless heating and cooling is assumed to involve abandoning ductwork outside the building enclosure and sealing the openings to the home. Elimination of duct leakage is included in the calculation of annual energy costs for the scenarios using ductless heating and cooling. Key assumptions and home characteristics for the modeling carried out in this research are provided in Table 18 below.

Table 18: Energy modeling assumptions and home characteristics.

Conditioned Square Feet	1,200 Square Feet
Number of bedrooms	3
Floor assembly	Typical for manufactured homes: Unconditioned crawlspace, vented Effective R-value R-15, with thermal bridging due to chassis structure
Wall assembly	Effective R-value R-11
Ceiling assembly	Effective R-value R-11
Windows	U factor 0.50 Solar heat gain coefficient 0.40 16 percent window-to-wall ratio
Infiltration	9 ACH50

Ongoing operational costs of the four electrification end uses were based on the energy consumption for each end use generated by REM/Rate. The heating and cooling costs are modeled individually for two representative climates.

Table 19: Annual energy costs of appliances in different scenarios.

Annual Operating Cost	Base Case – Electric, Resistance	Electric – Energy-Efficient	Electric – Power-Efficient
Water Heating	$1,290	$293	$381
Clothes Dryer	$297	$281	$281
Cooking	$224	$193	$193
Heating – Hot Climate	$645	$132	$117
Heating – Cold Climate	$4,484	$1,202	$1,085

Appendix B: Discussion of Relevant Sections of NEC 2023

The 2025 California Electrical Code, California Code of Regulations Title 24, Part 3, is based on the 2023 edition of NFPA 70®, NEC® (NFPA, NFPA Electrical Code Updates n.d.) (NFPA, NFPA Publications n.d.). Article 220 in NFPA 70-2023 describes two calculation methods for determining the required electrical service capacity for new construction. The method commonly known as the “basic” or “standard” calculation is explained in Part III of Article 220. The second, “optional” calculation, is described in Part IV. The optional method is more clearly defined than the standard load calculation method and is the foundation for the free online load calculators referenced in the Background section of this report. In every load calculation performed by the project team, the optional method resulted in a lower calculated maximum household electrical load than the standard load method.

The electrical code also describes two load calculation methods for determining if a new load can be added to an existing dwelling unit. Section 220.83 explains how to sum existing loads and then add new loads multiplied by a load factor. The second retrofit load calculation method, covered in section 220.87, calculates the existing dwelling base load as 125 percent of the highest household load recorded from one year or more metered data. If one year of data is not available, a minimum of 30 days of data can be used provided the data is collected at 15-minute increments or less and the data represents the worst case of seasonal loads. This method is not allowed if the electrical service panel has a photovoltaic or wind power system connected to it or uses any kind of load shaving system. The total of the base plus the nameplate rating of new loads must be less than the electrical service capacity (assumed to be 100 amps for this study).

Metering research has shown that the maximum electrical load in single family homes is less than that calculated by either the standard or optional method (Walker, PhD 2025). Therefore, there is often more “room” to electrify than the load calculations indicate. By using actual measured demand, Section 220.87 allows use of the underutilized “room” to implement electrification measures without having to upgrade electrical service.

Appendix C: Electrification Technology Comparisons

Table 20 through Table 27 present a consolidated comparison of the electrification technologies evaluated in this study, organized by control devices and appliance end uses. These tables summarize representative equipment options for load management, cooking, clothes drying, water heating, space conditioning, and combined HVAC and domestic hot water systems. For each technology category, the tables report key characteristics relevant to manufactured home electrification, including electrical load implications, equipment and installation costs, 10-year operating costs, efficiency metrics, and notable performance attributes. Note that the costs and performance metrics for each equipment category used in the analyses were collected from one representative model. Together, these tables provide the quantitative foundation for the scenario development and comparisons presented in the Findings section and support transparent evaluation of tradeoffs among electrification pathways within a 100-amp service constraint.

Table 20: C1 – load splitter technologies.

Technology	C1.1 Outlet Splitters	C2.2 Hard-Wired Splitters
Benefit to Load Calculation	Significant – essentially removes the water heater from the load calculation (4,500 W, 18.75 A at 240 V	Significant – essentially removes the water heater from the load calculation (4,500 W, 18.75 A at 240 V) or the dryer or EV charger (7200 W, 30 A at 240 V)
Number of Loads Switched	2	2
Maximum Circuit Load	9,600 W, 40 amps 240 V (NeoCharge Smart Splitter n.d.)	14,400 W, 60 amps 240 V (DIVVEE-60 Energy Management System n.d.)
Typical Uses	Share an outlet with a dryer and a hot water heater	• Share a circuit with a dryer and hot water heater • Share a circuit with a dryer and an EV charger
Equipment Cost	$494 (NEMA 10-50 Smart Splitter - EV/Appliance n.d.)	$1,044 (Loadshare 60A High Capacity Loadshare Device, NEMA 1, 208-240 VAC n.d.)
Electrician Cost	$0 - DIY	$800

Table 21: C2 – smart circuit switch technologies.

Technology	C2.1 Smart Circuit Switches
Benefit to Load Calculation	Significant – essentially removes a large new load (up to 60 amps at 240 V) from the load calculation
Number of Loads Switched	1
Maximum Circuit Load	14,400 W, 60 amps at 240 V[17]
Typical Uses	Connect a heat pump or EV charger
Equipment Cost	$771[18]
Electrician Cost	$800

Table 22: C3 – meter socket adapter technologies.

Technology	C3.1 MSA to Subpanel	C3.2 MSA to Single Load
Benefit to Load Calculation	Significant – ensures that every load connected through its subpanel will not cause total household use to exceed the service capacity	Makes it easy to add an EV charger – ensures that the EV charger will not cause total household use to exceed the service capacity
Number of Circuits Controlled	8 (240 V), 16 (120 V), or combination	1
Maximum Circuit Load	24,000 W, 100 amps at 240 V	7,680 W, 32 amps at 240 V (ConnectDER n.d.)
Typical Uses	Add multiple loads without exceeding 100-amp service	Connect an EV charger
Equipment Cost	TBA	$875 (Kane 2024)
Electrician Cost	No direct to customer sales data yet	No direct to customer sales data yet

Table 23: C4 – smart panel technologies.

Technology	C4.1 Smart Main Panel	C4.1 Smart Add-On and Subpanels
Benefit to Load Calculation	Very significant – manages and prioritizes every load in the house such that the service capacity is never exceeded	Significant – manages and prioritizes every new load connected to the subpanel/add-on panel or moved to the subpanel/add-on panel from the main panel. Ensures that the service capacity is never exceeded
Number of Circuits Controlled	40 (120 V), 20 (240 V), or a combination (SPAN Panel Main 40 n.d.)	12 (120 V), 6 (240 V), or a combination (LuminSmart n.d.)
Branch Load Limits	Max 100 amps per single pole branch circuit (SPAN Panel Main 40 n.d.)	6 breakers up to 60 amps plus 6 breakers up to 30 amps (LuminSmart n.d.)
Maximum Total Load	48,000 W, 200 amps at 240 V (SPAN Panel Main 40 n.d.)	N/A – the Lumin Smart Panel does not distribute power to multiple loads like a subpanel. Each individual load that it controls is separately wired from an upstream sub or main panel through the LSP then onto each load
Equipment Cost	$4100 (SPAN Panel Main 40 n.d.)	$2650 (Lumin ABB Smart Electrical Panel Indoor n.d.)
Electrician Cost	TBD	TBD

Table 24: A1 – cooking range electrification technology comparison.

Technology	Base Case	Efficient Alternatives	
	Electric Range, 30-Inch, 4 Radiant Burners	A1.3 Low Power Induction Range, No Battery	A1.2 Battery Integrated Induction Range
Equipment Cost	$687	$2,000	$5,999
Installation Cost	$40	$40	$40
Electrician Cost	$1,100	$0	$0
10-year Operating Cost	$2,136	$1,846	$1,846
Total Cost	$3,963	$3,886	$7,885
Electrical Load	9,600 W, 40 A at 240 V	1,800 W, 15 A at 120 V	1,800 W, 15 A at 120 V
Features	4 radiant burners	3 induction burners	4 induction burners

Table 25: A2 – clothes drying technology comparison.

Technology	Base Case	Efficient Alternatives		
	Electric Resistance Dryer	A2.1 120 V Heat Pump Dryer	A2.2 240 V Hybrid Heat Pump Dryer	A2.3 Combined Washer/Heat Pump Dryer
Equipment Cost	$698	$1,699	$1,498	$1,798
Installation Cost	$320	$0	$0	$0
Electrician Cost	$1,000	$0	$1,000	$0
Combined Energy Factor (CEF)	3.93	6.37	9.0	6.0
Annual Energy Use	595 kWh	367 kWh	260 kWh	390 kWh
Capacity	7.4 cu. ft.	4.6 cu. ft.	7.8 cu. ft.	4.0 cu. ft.
10-year Heating Cost	$2,836	$1,750	$1,239	$1,858
Total Cost	$4,854	$3,449	$3,737	$3,656

Table 26: A3 – hot water heating technology comparison.

Technology	Base Case	Efficient Alternatives			
	Electric Resistance Tank Water Heater	A2.1 120 V Unitary HPWH	A2.2 120 V Split HPWH	A2.3 PCM Water Heater	A3.4 240 V Hybrid HPWH
Equipment Cost	$579	$2,219	$3,350	$2,015	$1,549
Installation Cost	$864	$1,479	$2,500	$2,300	$1,479
Electrician Cost	$1,000	$0	$400	$1,000	$1,100
Uniform Energy Factor (UEF)	0.93	3.0	3.3	0.94	3.88
RESNET Annual Energy Usage	1891 kWh	586 kWh	533 kWh	1871 kWh	453 kWh
10-year Heating Cost	$9,013	$2,794	$2,540	$8,918	$2,160
Total Cost	$11,456	$6,492	$8,790	$14,233	$6,288
First Hour Rating (FHR)	61 gallons	55 gallons	50 gallons	53 gallons (not exactly FHR)	67 gallons
Recovery Rate, 90 deg F rise (GPH)	21 GPH	12 GPH	20 GPH	TBD	27 GPH

Table 27: A4 – space conditioning electrification technology comparison.

Technology	Base Case	Efficient Alternatives		
	Electric Downflow 15 kW Mobile Home Furnace	A4.1 3-ton Centrally Ducted, Cold Climate, High Efficiency Heat Pump	A4.2 Packaged Window Heat Pumps, 4X	A4.3 Ductless High Efficiency Heat Pumps
Cooling Technology	Central A/C unit or window A/C units	Same as above	Same as above	Same as above
Equipment Cost	$1,099	$5,706	$13,196	$11,068
Installation Cost	$1,900	$2,575	$0	$7,725
Electrician Cost	$2,200	$2,100	$1,294	$6,000
10-year Heating Cost	$58,212	$17,464	$17,464	$14,969
10-year Cooling Cost	$11,245	$7,497	$7,497	$5,623
Total Cost	$74,656	$35,342	$39,451	$45,385

Table 28: A5 – combined HVAC and water heating.

Technology	Efficient Alternatives	
	A5.1 Combined HVAC and DHW with Thermal Storage	A5.2 Combined HVAC and DHW
Cooling Technology	Same as above	Same as above
Equipment Cost	$12,000	TBD
Installation Cost	TBD	TBD
Electrician Cost	TBD	TBD
10-year Heating Cost	$17,464	$17,464
10-year Cooling Cost	$7,497	$7,497
10-year Hot Water Cost	$0 (included above)	$0 (included above)
Total Cost	$36,961	$TBD

Appendix D: Practical Guidance for Manufactured Homeowners

CalNEXT ENERGIZING CALIFORNIA'S FUTURE

Manufactured Home Electrification Guide

Improve your home with affordable appliances

This guide explains how manufactured homes can upgrade to modern electric appliances. Here are some benefits and questions to help you plan.

Why upgrade to electric?

Comfort
Heat pumps provide even heat in winter and quiet cooling in summer.

Health
Induction electric stoves cook quickly without unhealthy propane or gas fumes.

Environment
Electric appliances use California's clean renewable energy.

Built for manufactured homes

The newest generation of electric appliances plug into standard 120V wall outlets and work within 100 amps, the common capacity of the electric panel in a manufactured home.

120V

100 amps

Smart, affordable electric upgrades

Use efficient appliances with standard 120V outlets, like:

Micro Heat Pump
- Easy DIY window installation
- Heating + quiet AC in one system
- Better indoor comfort and air quality

Induction Cooking Range
- Fast, precise cooking
- Much easier to clean than gas
- No gas = healthier air + less risk of fire

Heat Pump Clothes Dryer
- Ventless, and gentle on clothes
- Option for space saving combo washer/dryer
- Saves on electric bill

Heat Pump Water Heater
- Saves on electric bill
- Fits manufactured home spaces
- No wiring or panel work needed

Smart Circuit Switches
- Prevents overloads
- A safe and flexible option to go fully electric over time
- No electric panel upgrade required

Find out more about CalNEXT at calnext.com

Program funded by ratepayers.

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Manufactured Home Electrification Guide

Talk with contractors about your long-term goals

Even if you are upgrading just one appliance today, plan for tomorrow. Here are some helpful questions to consider in your decision making.

Questions for your electrician

- Could a smart circuit switch help me go electric?
- Are plug-in appliances, like the ones listed, suitable for my house?
- Can we review my power usage history (using NEC 220.87) to see if I can switch to electric appliances?

Questions for your electric utility and park manager

- Does my home have its own electric meter?
- Are rebates available to help pay for electric appliances?

Questions for your mechanical contractor

- Are there micro heat pumps that do not require electric supplemental heat?
- Could a plug-in heat pump replace my gas heating?

Questions for your plumber

- Will a heat pump water heater fit in my home?
- Could a plug-in heat pump water heater meet our needs?